Criteria	JORC Code explanation	Comment
Metallurgical factors or assumptions	• The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential metallurgical methods, but the assumptions regarding metallurgical treatment processes and parameters made when reporting Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the metallurgical assumptions made.	• Saprolite will be sent to Pomalaa and processed as ferro nickel. • Limonite will be stocked as Low Grade Ore Management (LGOM) program.
Environmental factors or assumptions	• Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfields project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported. Where these aspects have not been considered this should be reported with an explanation of the environmental assumptions made.	• Waste will be backfilled to the pit.
Bulk density	• Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples. • The bulk density for bulk material must have been measured by methods that adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit. • Discuss assumptions for bulk density estimates used in the evaluation process of the different materials.	• Density is determined by dividing the core weight with the volume of core barrel. • Density also determined using Archimedes principle. • The average of density value of each domain is inputted to block model. • Average density for limonite is 1.75, while saprolite is 1.77
Classification	• The basis for the classification of the Mineral Resources into varying confidence categories. • Whether appropriate account has been taken of all relevant factors (ie relative confidence in tonnage/grade estimations, reliability of input data, confidence in continuity of geology and metal values, quality, quantity and distribution of the data).	• The mineral resources were estimated separately between limonite and saprolite. • Basis for mineral classification is Slope Regression (SR) from Ni estimated grade. • If SR ≥ 0.6, the resources classified as Measured.

Criteria	JORC Code explanation	Comment
	• Whether the result appropriately reflects the Competent Person's view of the deposit.	• If 0.2 ≤ SR < 0.6, the resource classified as Indicated. • If SR < 0.2, the resource classified as Inferred. • The classification based on SR has correlation with the borehole spacing. • SR ≥ 0.6 has correlation with borehole spacing 25 m. • SR 0.2 - 0.6 has correlation with borehole spacing 50 m. • SR < has correlation with borehole spacing 100 m and 200 m.
Audits or reviews	• The results of any audits or reviews of Mineral Resource estimates.	• The resource estimate not reviewed yet.
Discussion of relative accuracy/ confidence	• Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors that could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	•

Table 1 - JORC Code, 2012 Edition

Section 4 Estimation and Reporting of Ore Reserves of **Mornopo Prospect**

Criteria	JORC Code explanation	Comment
Mineral Resource estimate for conversion to Ore Reserves	• Description of the Mineral Resource estimate used as a basis for the conversion to an Ore Reserve. • Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Ore Reserves.	• Mineral resources model are estimated by Geomin (ANTAM's exploration unit). • The measured and indicated nickel resources are inclusive of mineral resources • Ore reserves estimated are classified based on measured and indicated resources into proved and probable ore reserves • Ore reserve estimate for nickel laterite is reported into Limonite and saprolite ore
Site visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• The Competent Person visited Moronopo Mine regularly between 2017-2019
Study status	• The type and level of study undertaken to enable Mineral Resources to be converted to Ore Reserves.Nature of the data used and of any assumptions made. • The Code requires that a study to at least Pre-Feasibility Study level has been undertaken to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable, and that material Modifying Factors have been considered.	• Moronopo nickel deposit is a brownfield expansion of existing operations • Updated Feasibility study has been done in 2018
Cut-off parameters	• The basis of the cut-off grade(s) or quality parameters applied.	• Ni > 1.5 % is the cut-off grade applied in Moronopo deposit
Mining factors or assumptions	• The method and assumptions used as reported in the Pre-Feasibility or Feasibility Study to convert the Mineral Resource to an Ore Reserve (i.e. either by application of appropriate factors by optimisation or by preliminary or detailed design). • The choice, nature and appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc. • The assumptions made regarding geotechnical parameters (eg pit slopes, stope sizes, etc), grade control and pre-production drilling.	• Pit optimization with industry standard software were undertaken. This optimisation utilised the Mineral Resources model together with cost, revenue, and mining parameter inputs. As a result, optimized block model were exported from the software. • During the above process, inferred Mineral Resources were excluded from pit optimization" • Conventional mining methods (truck and shovel) are utilised based on existing mine operation at Moronopo

Criteria	JORC Code explanation	Comment
	• The major assumptions made and Mineral Resource model used for pit and stope optimisation (if appropriate). • The mining dilution factors used. • In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed. • The mining recovery factors used. • Any minimum mining widths used. • Description of how the geological interpretation was used to control the resource estimates. • The manner in which Inferred Mineral Resources are utilised in mining studies and the sensitivity of the outcome to their inclusion. • The infrastructure requirements of the selected mining methods.	• The geotechnical parameters have been applied based on updated geotechnical studies in 2013. • Assumed from existing production data • Mining Dilution used is 3 % • Mining Recovery used is 93 % • Minimum mining width used is 25 m • Inferred are not utilized • Require ore stockyard, waste dump, Grizzly Screening, settling pond, Office, Townhouse, etc • Moronopo mine already have all the infrastructures required.
Metallurgical factors or assumptions	• The metallurgical process proposed and the appropriateness of that process to the style of mineralisation. • Whether the metallurgical process is well-tested technology or novel in nature. • The nature, amount and representativeness of metallurgical test work undertaken, the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied. • Any assumptions or allowances made for deleterious elements. • The existence of any bulk sample or pilot scale test work and the degree to which such samples are considered representative of the orebody as a whole. • For minerals that are defined by a specification, has the ore reserve estimation been based on the appropriate mineralogy to meet the specifications?	• Based on the mineral resources estimation data, Moronopo ore is meet the grade requirement for the proposed supply plan • Moronopo will supply ore for Feni Plant (Pomalaa and Haltim) and NPI Blast Furnace" • Pomalaa FeNi Plant is well tested and have been operated for 30 years • Antam's Feni Plant is already built in North Maluku • NPI Blast Furnace is a proven technology and will be adopted to process tapunopaka's ore • The ore meets the plant requirement • Antam only analyze 12 elements (Ni, Fe, SiO2, MgO , Co, CaO, Al2O3, Cr2O3, MnO, P2O5, SO3, TiO2) • The Feni Pomalaa plant is a proven operation for more than 30 years. No need to do any pilot test. • Antam's Feni Haltim Plant is already built in North Maluku. Met Test was already performed • The NPI Blast Furnace is a proven technology. Based on geochemical data, Moronopo ore meet the ore

Criteria	JORC Code explanation	Comment
		specification needed for NPI Blast Furnace" • Yes, based on geochemical data, Moronopo ore meet Feni Pomalaa ,Feni Haltim and NPI Blast Furnace ore specification
Environmental	• The status of studies of potential environmental impacts of the mining and processing operation. Details of waste rock characterisation and the consideration of potential sites, status of design options considered and, where applicable, the status of approvals for process residue storage and waste dumps should be reported.	• Environmental studies (AMDAL) based on Indonesia's Environmental Regulation has been done and approved by Government
Infrastructure	• The existence of appropriate infrastructure: availability of land for plant development, power, water, transportation (particularly for bulk commodities), labour, accommodation; or the ease with which the infrastructure can be provided, or accessed.	• Yes it is already appropriate
Costs	• The derivation of, or assumptions made, regarding projected capital costs in the study. • The methodology used to estimate operating costs. • Allowances made for the content of deleterious elements. • The source of exchange rates used in the study. • Derivation of transportation charges. • The basis for forecasting or source of treatment and refining charges, penalties for failure to meet specification, etc. • The allowances made for royalties payable, both Government and private.	• Capital cost were estimated based on Antam's Long Term Plan • Operating cost were estimated based on Moronopo historical production data • No deleterious element has been analyzed • Exchange rates obtained from assumption made in Antam's Annual Work Plan & Budget • Transportation costs were based on existing operation data • Assumed from existing production data • The allowances have been made for royalties to the government
Revenue factors	• The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc. • The derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.	• Metal price assumptions based on Antam's Long Term Plan 2019-2024 • Metal price based on Antam's Long Term Plan 2019-2024
Market assessment	• The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future. • A customer and competitor analysis along with the identification of likely market windows for the product. • Price and volume forecasts and the basis for these forecasts.	• Ore reserves estimation already based on Antam's future plan in which will absorb ore optimally • Antam delivers products aligned with its Mineral Resources and Ore Reserves which are successfully competed with nickel products supplied by other companies

Criteria	JORC Code explanation	Comment
	• For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.	• Forecast has been made by Antam's budgeting team • Antam delivers products aligned with its Mineral Resources and Ore Reserves, these products have changed over time and successfully meet the requirement for ore supply
Economic	• The inputs to the economic analysis to produce the net present value (NPV) in the study, the source and confidence of these economic inputs including estimated inflation, discount rate, etc. • NPV ranges and sensitivity to variations in the significant assumptions and inputs.	• Economic inputs are generated internally at Antam. The detail of this process is commercially sensitive and is not disclosed • Sensitivity has been made by various scenario
Social	• The status of agreements with key stakeholders and matters leading to social licence to operate.	• The Moronopo prospect is part of Antam's North Maluku Mining License (IUP) that have been granted baesd on Mineral and Coal Mining Regulation of 2009
Other	• To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves: • Any identified material naturally occurring risks. • The status of material legal agreements and marketing arrangements. • The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect that all necessary Government approvals will be received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third party on which extraction of the reserve is contingent.	• The risks has been analyzed in Antam's Long Term Plan 2019-2024 • Both has been performed • No issues regarding to the mineral tenement status & government and statutory approvals.
Classification	• The basis for the classification of the Ore Reserves into varying confidence categories. • Whether the result appropriately reflects the Competent Person's view of the deposit. • The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).	• All measured mineral resources have been convert into Proved Ore Reserves, there is no consideration yet to put some proportion of measured mineral resources to be converted into probable ore reserve • The competent person satisfy that the Ore Reserves classification reflects the outcome of technical and economical studies • The classification of proven and probable ore reserves is based on the confidence

Criteria	JORC Code explanation	Comment
		categories of measured and indicated resources. The ore reseves for Moronopo consist of 59% Proved Reserves and 41% Probable Reserves
Audits or reviews	• The results of any audits or reviews of Mineral Reserve estimates.	• The ore reserves estimate have not been reviewed yet
Discussion of relative accuracy/ confidence	• Where appropriate a statement of the relative accuracy and confidence level in the Ore Reserve estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage. • It is recognised that this may not be possible or appropriate in all circumstances. These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	• Data accuracy could be improved by conducting robust operation monitoring • Annual Mining Plan reviewed by comparing with ANTAM's Annual Work Plan & Budget • Commodity price, mining cost, and government's regulation give the biggest impact for reserves estimation.. • Mining reconciliation have been conducted regularly to compare mine plan vs actual production.

Table 1 - JORC Code, 2012 Edition

Section 3 Estimation and Reporting of Mineral Resources of **Sangaji Prospect**

Criteria	JORC Code explanation	Comment
Database integrity	• Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes. • Data validation procedures used	• Inputing data system and data storage development makes the database more reliable. • Data (collar, lithology, assay) input use application developed by Geomin Unit of PT ANTAM in Microsoft Access has automatic function to create information such as borehole interception (FROM/TO), sample number, etc. to avoid mistype. • Data for resource estimation are from database division which is collected from exploration division. • The database is validated by exploration division as first validation step when data collection, then validated by database division prior to stored and managed. • Data from database division then validated by resource estimation division prior to be processed. • The data validation such as validate the collar, validate the borehole interception, and validate the assay.
Site visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• Site visit have been conducted several times by Competent Person. • Competent person discussed with exploration team about database when visit the site.
Geological interpretation	• Confidence in (or conversely, the uncertainty of the geological interpretation of the mineral deposit. • Nature of the data used and of any assumptions made. • The effect, if any, of alternative interpretations on Mineral Resource estimation. • The use of geology in guiding and controlling Mineral Resource estimation. • The factors affecting continuity both of grade and geology.	• Geological interpretation has been undertaked in Datamine StudioRM mining software. • Geological interpretation based on geological domain (overburden, limonite, saprolite, and bedrock). • The geological domain was crosschecked by Explonatory Data Analysis. • Most of the old database does not have lithology information, so the geological domain is defined using assay (Ni, Fe, MgO, and SiO_2) by create vertical profile and checked by ternary diagram. • No alternative interpretation. • Each geological domain model is built in three dimensions.

Criteria	JORC Code explanation	Comment
		• Grade estimation for limonite and saprolite was estimated separately. • Boundary of laterite is a limit of geological continuity.
Dimensions	• The extent and variability of the Mineral Resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.	• The area of laterite is about 8,700 Ha. • The depth of laterite below surface is 1.3 m in average.
Estimation and modelling techniques	• The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domaining, interpolation parameters and maximum distance of extrapolation from data points. If a computer assisted estimation method was chosen include a description of computer software and parameters used. • The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data. • The assumptions made regarding recovery of by-products. • Estimation of deleterious elements or other non-grade variables of economic significance (eg sulphur for acid mine drainage characterisation). • In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed. • Any assumptions behind modelling of selective mining units. • Any assumptions about correlation between variables. • Description of how the geological interpretation was used to control the resource estimates. • Discussion of basis for using or not using grade cutting or capping. • The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available.	• The resource estimation has been undertaken in Datamine StudioRM mining software. • The grade estimation is controlled by geological interpretation. Limonite and saprolite was estimated separately based on geological domain. Sample limonite estimated by limonite sample only and saprolite estimated by saprolite sample only. • Ordinary Kriging (OK) has been applied to estimate the grades, but for several minor grade estimated using Inverse Distance Square (IDS) due to the variogram cannot be obtained. • Variography was analysed in flat elevation. • The grade was estimated into block model in flat elevation and returned to actual elevation after grade estimation. • Block model size is a half of borehole spacing. This block size is a rule of thumb to create block model. • The borehole spacing are 25 m × 25 m, 50 m × 50 m, 100 m × 100 m, and 200 m × 200 m. so, the parent cell of block model is created in three size depend on the borehole spacing. The three parents cell size are 12.5 m × 12.5 m, 25 m × 25 m, and 50 m × 50 m. Although the parent cell is different for each borehole spacing but the cell size is 12.5 m × 12.5 m to keep the block model volume is similar with the wireframe volume. • The searching volume is ellipse. Three searching volume was applied to interpolate the grades. First search ellipse as a main searching volume is 40 m × 40 m × 10 m. The second search ellipse is three times of first search ellipse and the third search ellipse is six times of first search ellipse.

Criteria	JORC Code explanation	Comment
		• Minimum sample for grade estimation is 3 and maximum is 5 for first search ellipse, while for second and third search ellipse use 3 and 8 as minimum and maximum sample. • Grade cutting was used to get better data population then get better variogram experimental to be modelled. • Swath plot was used to validate the grade in block model compare to the grade in sample. • Another validation is create sections to display grade in block model and borehole, then compare the distribution.
Moisture	• Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.	• Tonnages are stated on wet basis and dry basis. • Moisture content (MC) was determined by analysis in internal assay laboratorium. • Average MC for limonite is 30%, while saprolite is 24%.
Cut-off parameters	• The basis of the adopted cut-off grade(s) or quality parameters applied.	• Cut-off grade was applied to estimate the resources. • Consideration to define cut-off grade is the ore utilization. • Cut-off grade for limonite is 1.2 % Ni. • Cut-off grade for saprolite is 1.5 % Ni due to the utilization plan for Rotary Kiln Electric Furnace (RKEF) and Blast Furnace (BF).
Mining factors or assumptions	• Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential mining methods, but the assumptions made regarding mining methods and parameters when estimating Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the mining assumptions made.	• Mining method in Sangaji is undertaken by open pit.
Metallurgical factors or assumptions	• The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider	• Saprolite will be processed as ferro nickel (RKEF) and nickel pig iron (Blas Furnace). • Limonite will be processed using HPAL.

Criteria	JORC Code explanation	Comment
	potential metallurgical methods, but the assumptions regarding metallurgical treatment processes and parameters made when reporting Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the metallurgical assumptions made.	
Environmental factors or assumptions	• Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfields project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported. Where these aspects have not been considered this should be reported with an explanation of the environmental assumptions made.	• Waste will be backfilled to the pit.
Bulk density	• Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples. • The bulk density for bulk material must have been measured by methods that adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit. • Discuss assumptions for bulk density estimates used in the evaluation process of the different materials.	• Density is determined by dividing the core weight with the volume of core barrel. • Density also determined using Archimedes principle. • The average of density value of each domain is inputted to block model. • Average density for limonite is 1.71, while saprolite is 1.78
Classification	• The basis for the classification of the Mineral Resources into varying confidence categories. • Whether appropriate account has been taken of all relevant factors (ie relative confidence in tonnage/grade estimations, reliability of input data, confidence in continuity of geology and metal values,	• The mineral resources were estimated separately between limonite and saprolite. • Basis for mineral classification is Slope Regression (SR) from Ni estimated grade. • If SR ≥ 0.6, the resources classified as Measured. • If 0.2 ≤ SR < 0.6, the resource classified as Indicated.

Criteria	JORC Code explanation	Comment
	quality, quantity and distribution of the data). • Whether the result appropriately reflects the Competent Person's view of the deposit.	• If SR < 0.2, the resource classified as Inferred. • The classification based on SR has correlation with the borehole spacing. • SR ≥ 0.6 has correlation with borehole spacing 25 m. • SR 0.2 - 0.6 has correlation with borehole spacing 50 m. • SR < has correlation with borehole spacing 100 m and 200 m.
Audits or reviews	• The results of any audits or reviews of Mineral Resource estimates.	• The resource estimate not reviewed yet.
Discussion of relative accuracy/ confidence	• Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors that could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	• Relative accuracy/confidence of resource estimate can not compare yet with the production due to the Sangaji prospect is not mined yet. •

Table 1 - JORC Code, 2012 Edition

Section 4 Estimation and Reporting of Ore Reserves of **Sangaji Prospect**

Criteria	JORC Code explanation	Comment
Mineral Resource estimate for conversion to Ore Reserves	• Description of the Mineral Resource estimate used as a basis for the conversion to an Ore Reserve. • Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Ore Reserves.	• Mineral resources model are estimated by Geomin (ANTAM's exploration unit). • The measured and indicated nickel resources are inclusive of mineral resources • Ore reserves estimated are classified based on measured and indicated resources into proved and probable ore reserves • Ore reserve estimate for nickel laterite is reported into Limonite and saprolite ore
Site visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• The Competent Person visited Sangaji in 2019
Study status	• The type and level of study undertaken to enable Mineral Resources to be converted to Ore Reserves.Nature of the data used and of any assumptions made. • The Code requires that a study to at least Pre-Feasibility Study level has been undertaken to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable, and that material Modifying Factors have been considered.	• Sangaji nickel deposit is a greenfield project, yet it is part of the prospects in Antam's North Maluku Nickel Unit • Updated Feasibility study has been done in 2018
Cut-off parameters	• The basis of the cut-off grade(s) or quality parameters applied.	• Ni > 1.5 % is the cut-off grade applied for Limonite ore • Ni > 1.5 % is the cut-off grade applied for Saprolite ore
Mining factors or assumptions	• The method and assumptions used as reported in the Pre-Feasibility or Feasibility Study to convert the Mineral Resource to an Ore Reserve (i.e. either by application of appropriate factors by optimisation or by preliminary or detailed design). • The choice, nature and appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc. • The assumptions made regarding geotechnical parameters (eg pit slopes, stope sizes, etc), grade control and pre-production drilling.	• Pit optimization with industry standard software were undertaken. This optimisation utilised the Mineral Resources model together with cost, revenue, and mining parameter inputs. As a result, optimized block model were exported from the software. • During the above process, inferred Mineral Resources were excluded from pit optimization" • Conventional mining methods (truck and shovel) will be utilized based on existing mine operation at Antam's North

Criteria	JORC Code explanation	Comment
	• The major assumptions made and Mineral Resource model used for pit and stope optimisation (if appropriate). • The mining dilution factors used. • In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed. • The mining recovery factors used. • Any minimum mining widths used. • Description of how the geological interpretation was used to control the resource estimates. • The manner in which Inferred Mineral Resources are utilised in mining studies and the sensitivity of the outcome to their inclusion. • The infrastructure requirements of the selected mining methods.	Maluku Mine. Sangaji mine will be equpped with screening station to separate boulders. • The geotechnical parameters have been applied based on geotechnical studies in Moronopo which is the nearest prospect from Sangaji • The geotechnical studies for Sangaji is on going. The results will be reported in March 2020.Assumed from existing production data • Mining Dilution used is 3 % • Mining Recovery used is 93 % • Minimum mining width used is 25 m • Inferred are not utilized • No development yet in Sangaji, so it requires access road, ore stockyard, waste dump, Grizzly Screening, settling pond, Office, etc
Metallurgical factors or assumptions	• The metallurgical process proposed and the appropriateness of that process to the style of mineralisation. • Whether the metallurgical process is well-tested technology or novel in nature. • The nature, amount and representativeness of metallurgical test work undertaken, the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied. • Any assumptions or allowances made for deleterious elements. • The existence of any bulk sample or pilot scale test work and the degree to which such samples are considered representative of the orebody as a whole. • For minerals that are defined by a specification, has the ore reserve estimation been based on the appropriate mineralogy to meet the specifications?	• Based on the mineral resources estimation data, Sangaji ore is meet the grade requirement for the proposed supply plan • Sangaji will supply ore for Feni Plant (Haltim) and NPI Blast Furnace • Antam's Feni Plant is already built in North Maluku • NPI Blast Furnace is a proven technology and will be adopted to process Sangaji's ore • The ore meets the plant requirement • Antam only analyze 12 elements (Ni, Fe, SiO2, MgO , Co, CaO, Al2O3, Cr2O3, MnO, P2O5, SO3, TiO2) • Antam's Feni Haltim Plant is already built in North Maluku. • The NPI Blast Furnace is a proven technology. Based on geochemical data, Sangaji ore meet the ore specification needed for NPI Blast Furnace • Yes, based on geochemical data, Sangaji ore meet Feni Haltim and NPI Blast Furnace
Environmental	• The status of studies of potential environmental impacts of the mining and	• Environmental studies (AMDAL) based on Indonesia's Environmental Regulation

Criteria	JORC Code explanation	Comment
	processing operation. Details of waste rock characterisation and the consideration of potential sites, status of design options considered and, where applicable, the status of approvals for process residue storage and waste dumps should be reported.	has been done and approved by Government
Infrastructure	• The existence of appropriate infrastructure: availability of land for plant development, power, water, transportation (particularly for bulk commodities), labour, accommodation; or the ease with which the infrastructure can be provided, or accessed.	• Infrastructure will be built to support Sangaji project.
Costs	• The derivation of, or assumptions made, regarding projected capital costs in the study. • The methodology used to estimate operating costs. • Allowances made for the content of deleterious elements. • The source of exchange rates used in the study. • Derivation of transportation charges. • The basis for forecasting or source of treatment and refining charges, penalties for failure to meet specification, etc. • The allowances made for royalties payable, both Government and private.	• Capital cost were estimated based on Antam's Long Term Plan • Operating cost will be estimated based on Moronopo historical production data • No deleterious element has been analyzed • Exchange rates obtained from assumption made in Antam's Annual Work Plan & Budget • Transportation costs were based on existing operation data • Assumed from existing production data • The allowances have been made for royalties to the government
Revenue factors	• The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc. • The derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.	• Metal price assumptions based on Antam's Long Term Plan 2019-2024 • Metal price based on Antam's Long Term Plan 2019-2024
Market assessment	• The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future. • A customer and competitor analysis along with the identification of likely market windows for the product. • Price and volume forecasts and the basis for these forecasts. • For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.	• Ore reserves estimation already based on Antam's future plan in which will absorb ore optimally • Antam delivers products aligned with its Mineral Resources and Ore Reserves which are successfully competed with nickel products supplied by other companies • Forecast has been made by Antam's budgeting team • Antam delivers products aligned with its Mineral Resources and Ore Reserves, these products have changed over time and successfully meet the requirement for ore supply

Criteria	JORC Code explanation	Comment
Economic	• The inputs to the economic analysis to produce the net present value (NPV) in the study, the source and confidence of these economic inputs including estimated inflation, discount rate, etc. • NPV ranges and sensitivity to variations in the significant assumptions and inputs.	• Economic inputs are generated internally at Antam. The detail of this process is commercially sensitive and is not disclosed • Sensitivity has been made by various scenario
Social	• The status of agreements with key stakeholders and matters leading to social licence to operate.	• The Sangaji prospect is part of Antam's North Maluku Mining License (IUP) that have been granted baesd on Mineral and Coal Mining Regulation of 2009
Other	• To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves: • Any identified material naturally occurring risks. • The status of material legal agreements and marketing arrangements. • The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect that all necessary Government approvals will be received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third party on which extraction of the reserve is contingent.	• The risks has been analyzed in Antam's Long Term Plan 2019-2024 • Both has been performed • No issues regarding to the mineral tenement status & government and statutory approvals.
Classification	• The basis for the classification of the Ore Reserves into varying confidence categories. • Whether the result appropriately reflects the Competent Person's view of the deposit. • The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).	• All measured mineral resources have been convert into Proved Ore Reserves, there is no consideration yet to put some proportion of measured mineral resources to be converted into probable ore reserve • The competent person satisfy that the Ore Reserves classification reflects the outcome of technical and economical studies • The classification of proven and probable ore reserves is based on the confidence categories of measured and indicated resources. The ore reseves for Sangaji consist of 22% Proved Reserves and 78% Probable Reserves
Audits or reviews	• The results of any audits or reviews of Mineral Reserve estimates.	• The ore reserves estimate have not been reviewed yet
Discussion of relative	• Where appropriate a statement of the relative accuracy and confidence level in the Ore	• Data accuracy could be improved by conducting robust operation monitoring

Criteria	JORC Code explanation	Comment
accuracy/ confidence	Reserve estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage. • It is recognised that this may not be possible or appropriate in all circumstances. These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	• Annual Mining Plan reviewed by comparing with ANTAM's Annual Work Plan & Budget • Commodity price, mining cost, and government's regulation give the biggest impact for reserves estimation.. • Mining reconciliation have been conducted regularly to compare mine plan vs actual production.

Table 1 - JORC Code, 2012 Edition

Section 3 Estimation and Reporting of Mineral Resources of **Pomalaa Prospect**

Criteria	JORC Code explanation	Comment
Database integrity	• Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes. • Data validation procedures used	• Inputing data system and data storage development makes the database more reliable. • Data (collar, lithology, assay) input use application developed by Geomin Unit of PT ANTAM in Microsoft Access has automatic function to create information such as borehole interception (FROM/TO), sample number, etc. to avoid mistype. • Data for resource estimation are from database division which is collected from exploration division. • The database is validated by exploration division as first validation step when data collection, then validated by database division prior to stored and managed. • Data from database division then validated by resource estimation division prior to be processed. • The data validation such as validate the collar, validate the borehole interception, and validate the assay.
Site visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• Site visit have been conducted several times by Competent Person. • Competent person discussed with exploration team about database when visit the site.
Geological interpretation	• Confidence in (or conversely, the uncertainty of the geological interpretation of the mineral deposit. • Nature of the data used and of any assumptions made. • The effect, if any, of alternative interpretations on Mineral Resource estimation. • The use of geology in guiding and controlling Mineral Resource estimation. • The factors affecting continuity both of grade and geology.	• Geological interpretation has been undertaked in Datamine StudioRM mining software. • Geological interpretation based on geological domain (overburden, limonite, saprolite, and bedrock). • The geological domain was crosschecked by Explonatory Data Analysis. • Most of the old database does not have lithology information, so the geological domain is defined using assay (Ni, Fe, MgO, and SiO_2) by create vertical profile and checked by ternary diagram. • No alternative interpretation. • Each geological domain model is built in three dimensions.

Criteria	JORC Code explanation	Comment
		• Grade estimation for limonite and saprolite was estimated separately. • Boundary of laterite is a limit of geological continuity.
Dimensions	• The extent and variability of the Mineral Resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.	• The area of laterite is about 2,700 Ha. • The depth of laterite below surface is 2.2 m in average.
Estimation and modelling techniques	• The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domaining, interpolation parameters and maximum distance of extrapolation from data points. If a computer assisted estimation method was chosen include a description of computer software and parameters used. • The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data. • The assumptions made regarding recovery of by-products. • Estimation of deleterious elements or other non-grade variables of economic significance (eg sulphur for acid mine drainage characterisation). • In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed. • Any assumptions behind modelling of selective mining units. • Any assumptions about correlation between variables. • Description of how the geological interpretation was used to control the resource estimates. • Discussion of basis for using or not using grade cutting or capping. • The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available.	• The resource estimation has been undertaken in Datamine StudioRM mining software. • The grade estimation is controlled by geological interpretation. Limonite and saprolite was estimated separately based on geological domain. Sample limonite estimated by limonite sample only and saprolite estimated by saprolite sample only. • Ordinary Kriging (OK) has been applied to estimate the grades, but for several minor grade estimated using Inverse Distance Square (IDS) due to the variogram can not be obtained. • Variography was analysed in flat elevation. • The grade was estimated into block model in flat elevation and returned to actual elevation after grade estimation. • Block model size is a half of borehole spacing. This block size is a rule of thumb to create block model. • The borehole spacing are 25 m × 25 m, 50 m × 50 m, 100 m × 100 m, and 200 m × 200 m. so, the parent cell of block model is created in three size depend on the borehole spacing. The three parents cell size are 12.5 m × 12.5 m, 25 m × 25 m, and 50 m × 50 m. Although the parent cell is different for each borehole spacing but the cell size is 12.5 m × 12.5 m to keep the block model volume is similar with the wireframe volume. • The searching volume is ellipse. Three searching volume was applied to interpolate the grades. First search ellipse as a main searching volume is 40 m × 40 m × 10 m. The second search ellipse is

Criteria	JORC Code explanation	Comment
		three times of first search ellipse and the third search ellipse is six times of first search ellipse. • Minimum sample for grade estimation is 3 and maximum is 5 for first search ellipse, while for second and third search ellipse use 3 and 8 as minimum and maximum sample. • Grade cutting was used to get better data population then get better variogram experimental to be modelled. • Swath plot was used to validate the grade in block model compare to the grade in sample. • Another validation is create sections to display grade in block model and borehole, then compare the distribution.
Moisture	• Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.	• Tonnages are stated on wet basis and dry basis. • Moisture content (MC) was determined by analysis in internal assay laboratorium. • Average MC for limonite is 32%, while saprolite is 26%.
Cut-off parameters	• The basis of the adopted cut-off grade(s) or quality parameters applied.	• Cut-off grade was applied to estimate the resources. • Consideration to define cut-off grade is the ore utilization. • Cut-off grade for limonite is 1.2 % Ni due to the utilization plan of low grade ore management. • Cut-off grade for saprolite is 1.5 % Ni due to the utilization plan for Rotary Kiln Electric Furnace (RKEF).
Mining factors or assumptions	• Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential mining methods, but the assumptions made regarding mining methods and parameters when estimating Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the mining assumptions made.	• Mining method in Pomalaa is undertaken by open pit.

Criteria	JORC Code explanation	Comment
Metallurgical factors or assumptions	• The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential metallurgical methods, but the assumptions regarding metallurgical treatment processes and parameters made when reporting Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the metallurgical assumptions made.	• Saprolite will be processed as ferro nickel. • Limonite will be stocked as Low Grade Ore Management (LGOM) program.
Environmental factors or assumptions	• Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfields project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported. Where these aspects have not been considered this should be reported with an explanation of the environmental assumptions made.	• Waste will be backfilled to the pit.
Bulk density	• Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples. • The bulk density for bulk material must have been measured by methods that adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit. • Discuss assumptions for bulk density estimates used in the evaluation process of the different materials.	• Density is determined by dividing the core weight with the volume of core barrel. • Density also determined using Archimedes principle. • The average of density value of each domain is inputted to block model. • Average density for limonite is 1.86, while saprolite is 1.75
Classification	• The basis for the classification of the Mineral Resources into varying confidence categories. • Whether appropriate account has been taken of all relevant factors (ie relative confidence in tonnage/grade estimations, reliability of input data, confidence in continuity of geology and metal values, quality, quantity and distribution of the data).	• The mineral resources were estimated separately between limonite and saprolite. • Basis for mineral classification is Slope Regression (SR) from Ni estimated grade. • If SR ≥ 0.6, the resources classified as Measured. • If 0.2 ≤ SR < 0.6, the resource classified as Indicated.

Criteria	JORC Code explanation	Comment
	• Whether the result appropriately reflects the Competent Person's view of the deposit.	• If SR < 0.2, the resource classified as Inferred. • The classification based on SR has correlation with the borehole spacing. • SR ≥ 0.6 has correlation with borehole spacing 25 m. • SR 0.2 - 0.6 has correlation with borehole spacing 50 m. • SR < has correlation with borehole spacing 100 m and 200 m.
Audits or reviews	• The results of any audits or reviews of Mineral Resource estimates.	• The resource estimate not reviewed yet.
Discussion of relative accuracy/ confidence	• Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors that could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	•

Table 1 - JORC Code, 2012 Edition

Section 4 Estimation and Reporting of Ore Reserves of **Pomalaa Prospect**

Criteria	JORC Code explanation	Comment
Mineral Resource estimate for conversion to Ore Reserves	• Description of the Mineral Resource estimate used as a basis for the conversion to an Ore Reserve. • Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Ore Reserves.	• Mineral resources model are estimated by Geomin (ANTAM's exploration unit). • The measured and indicated nickel resources are inclusive of mineral resources • Ore reserves estimated are classified based on measured and indicated resources into proved and probable ore reserves • Ore reserve estimate for nickel laterite is reported into Limonite and saprolite ore
Site visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• The Competent Person visited Pomalaa regularly between in 2013-2019
Study status	• The type and level of study undertaken to enable Mineral Resources to be converted to Ore Reserves.Nature of the data used and of any assumptions made. • The Code requires that a study to at least Pre-Feasibility Study level has been undertaken to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable, and that material Modifying Factors have been considered.	• Pomalaa nickel deposit is a brownfield expansion of existing operation • Updated Feasibility study has been done in 2018
Cut-off parameters	• The basis of the cut-off grade(s) or quality parameters applied.	• Ni > 1.8 % is the cut-off grade applied for both Limonite and Saprolite ore • The CoG is changing because of export ban regulation, therefore Pomalaa can't sell MG ore (Ore with Ni grade 1.5-1.8 %)
Mining factors or assumptions	• The method and assumptions used as reported in the Pre-Feasibility or Feasibility Study to convert the Mineral Resource to an Ore Reserve (i.e. either by application of appropriate factors by optimisation or by preliminary or detailed design). • The choice, nature and appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc.	• Pit optimization with industry standard software were undertaken. This optimisation utilised the Mineral Resources model together with cost, revenue, and mining parameter inputs. As a result, optimized block model were exported from the software. • During the above process, inferred Mineral Resources were excluded from pit optimization"

Criteria	JORC Code explanation	Comment
	• The assumptions made regarding geotechnical parameters (eg pit slopes, stope sizes, etc), grade control and pre-production drilling. • The major assumptions made and Mineral Resource model used for pit and stope optimisation (if appropriate). • The mining dilution factors used. • In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed. • The mining recovery factors used. • Any minimum mining widths used. • Description of how the geological interpretation was used to control the resource estimates. • The manner in which Inferred Mineral Resources are utilised in mining studies and the sensitivity of the outcome to their inclusion. • The infrastructure requirements of the selected mining methods.	• Conventional mining methods (truck and shovel) will be utilized based on existing mine operation at Pomalaa Mine.. • The geotechnical parameters have been applied based on updated geotechnical studies in 2018. • Assumed from existing production data • Mining Dilution used is 3 % • Mining Recovery used is 93 % • Minimum mining width used is 12.5 m • Inferred are not utilized • Requires access road, ore stockyard, waste dump, settling pond, Office, etc. • Pomalaa already have all the infrastructures required.
Metallurgical factors or assumptions	• The metallurgical process proposed and the appropriateness of that process to the style of mineralisation. • Whether the metallurgical process is well-tested technology or novel in nature. • The nature, amount and representativeness of metallurgical test work undertaken, the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied. • Any assumptions or allowances made for deleterious elements. • The existence of any bulk sample or pilot scale test work and the degree to which such samples are considered representative of the orebody as a whole. • For minerals that are defined by a specification, has the ore reserve estimation been based on the appropriate mineralogy to meet the specifications?	• Based on the mineral resources estimation data, Pomalaa ore is meet the grade requirement for the proposed plant. • Pomalaa mine has been supplied Feni Pomalaa plant for more than 30 years" • Pomalaa FeNi Plant is well tested and have been operated for 30 years • The ore meets the plant requirement • Antam only analyze 12 elements (Ni, Fe, SiO2, MgO , Co, CaO, Al2O3, Cr2O3, MnO, P2O5, SO3, TiO2) • The Feni Pomalaa plant is a proven operation foe more than 30 years. No need to do any pilot test. • Yes, based on geochemical data, Pomalaa ore meet Feni Plant ore specification
Environmental	• The status of studies of potential environmental impacts of the mining and processing operation. Details of waste rock characterisation and the consideration of potential sites, status of design options considered and, where applicable, the status of	• Environmental stucies (AMDAL) based on Indonesia's Environmental Regulation has been done and approved by Government.

Criteria	JORC Code explanation	Comment
	approvals for process residue storage and waste dumps should be reported.	
Infrastructure	• The existence of appropriate infrastructure: availability of land for plant development, power, water, transportation (particularly for bulk commodities), labour, accommodation; or the ease with which the infrastructure can be provided, or accessed.	• Yes, it is already appropriate
Costs	• The derivation of, or assumptions made, regarding projected capital costs in the study. • The methodology used to estimate operating costs. • Allowances made for the content of deleterious elements. • The source of exchange rates used in the study. • Derivation of transportation charges. • The basis for forecasting or source of treatment and refining charges, penalties for failure to meet specification, etc. • The allowances made for royalties payable, both Government and private.	• Pomalaa is an on going operation, sustain capital cost is proposed regularly by the operation • Operating cost were estimated based on Pomalaa historical production data • No deleterious element has been analyzed • Exchange rates obtained from assumption made in Antam's Annual Work Plan & Budget • Transportation costs were based on existing operation data • Assumed from existing production data • The allowances have been made for royalties to the government
Revenue factors	• The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc. • The derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.	• Metal price assumptions based on Antam's Long Term Plan 2019-2024 • Metal price based on Antam's Long Term Plan 2019-2024
Market assessment	• The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future. • A customer and competitor analysis along with the identification of likely market windows for the product. • Price and volume forecasts and the basis for these forecasts. • For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.	• Ore reserves estimation already based on Antam's future plan in which will absorb ore optimally • Antam delivers products aligned with its Mineral Resources and Ore Reserves which are successfully competed with nickel products supplied by other companies • Forecast has been made by Antam's budgeting team • Antam delivers products aligned with its Mineral Resources and Ore Reserves, these products have changed over time and successfully meet the requirement for ore supply
Economic	• The inputs to the economic analysis to produce the net present value (NPV) in the study, the source and confidence of these economic	• Economic inputs are generated internally at Antam. The detail of this process is commercially sensitive and is not disclosed

Criteria	JORC Code explanation	Comment
	inputs including estimated inflation, discount rate, etc. • NPV ranges and sensitivity to variations in the significant assumptions and inputs.	• Sensitivity has been made by various scenario
Social	• The status of agreements with key stakeholders and matters leading to social licence to operate.	• The Pomalaa mine is part of Antam's Southeast Sulawesi Mining License (IUP) that have been granted based on Mineral and Coal Mining Regulation of 2009. Any necessary license regarding environmental and social also have been obtained
Other	• To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves: • Any identified material naturally occurring risks. • The status of material legal agreements and marketing arrangements. • The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect that all necessary Government approvals will be received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third party on which extraction of the reserve is contingent.	• The risks has been analyzed in Antam's Long Term Plan 2019-2024 • Both has been performed • No issues regarding to the mineral tenement status & government and statutory approvals.
Classification	• The basis for the classification of the Ore Reserves into varying confidence categories. • Whether the result appropriately reflects the Competent Person's view of the deposit. • The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).	• All measured mineral resources have been convert into Proved Ore Reserves, there is no consideration yet to put some proportion of measured mineral resources to be converted into probable ore reserve • The competent person satisfy that the Ore Reserves classification reflects the outcome of technical and economical studies • The classification of proven and probable ore reserves is based on the confidence categories of measured and indicated resources. The ore reseves for Pomalaa consist of 41% Proved Reserves and 59% Probable Reserves
Audits or reviews	• The results of any audits or reviews of Mineral Reserve estimates.	• The ore reserves estimate have not been reviewed yet
Discussion of relative	• Where appropriate a statement of the relative accuracy and confidence level in the Ore	• Data accuracy could be improved by conducting robust operation monitoring

Criteria	JORC Code explanation	Comment
accuracy/ confidence	Reserve estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage. • It is recognised that this may not be possible or appropriate in all circumstances. These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	• Annual Mining Plan reviewed by comparing with ANTAM's Annual Work Plan & Budget • Commodity price, mining cost, and government's regulation give the biggest impact for reserves estimation.. • Mining reconciliation have been conducted regularly to compare mine plan vs actual production.

Table 1 - JORC Code, 2012 Edition

Section 3 Estimation and Reporting of Mineral Resources of **Tapunopaka Prospect**

Criteria	JORC Code explanation	Comment
Database integrity	• Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes. • Data validation procedures used	• Inputing data system and data storage development makes the database more reliable. • Data (collar, lithology, assay) input use application developed by Geomin Unit of PT ANTAM in Microsoft Access has automatic function to create information such as borehole interception (FROM/TO), sample number, etc. to avoid mistype. • Data for resource estimation are from database division which is collected from exploration division. • The database is validated by exploration division as first validation step when data collection, then validated by database division prior to stored and managed. • Data from database division then validated by resource estimation division prior to be processed. • The data validation such as validate the collar, validate the borehole interception, and validate the assay.
Site visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• Site visit have been conducted several times by Competent Person. • Competent person discussed with exploration team about database when visit the site.
Geological interpretation	• Confidence in (or conversely, the uncertainty of) the geological interpretation of the mineral deposit. • Nature of the data used and of any assumptions made. • The effect, if any, of alternative interpretations on Mineral Resource estimation. • The use of geology in guiding and controlling Mineral Resource estimation. • The factors affecting continuity both of grade and geology.	• Geological interpretation has been undertaked in Datamine StudioRM mining software. • Geological interpretation based on geological domain (overburden, limonite, saprolite, and bedrock). • The geological domain was crosschecked by Explonatory Data Analysis. • Most of the old database does not have lithology information, so the geological domain is defined using assay (Ni, Fe, MgO, and SiO_2) by create vertical profile and checked by ternary diagram. • No alternative interpretation. • Each geological domain model is built in three dimensions.

Criteria	JORC Code explanation	Comment
		• Grade estimation for limonite and saprolite was estimated separately. • Boundary of laterite is a limit of geological continuity.
Dimensions	• The extent and variability of the Mineral Resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.	• The area of laterite is about 949 Ha. • The depth of laterite below surface is 1.1 m in average.
Estimation and modelling techniques	• The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domaining, interpolation parameters and maximum distance of extrapolation from data points. If a computer assisted estimation method was chosen include a description of computer software and parameters used. • The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data. • The assumptions made regarding recovery of by-products. • Estimation of deleterious elements or other non-grade variables of economic significance (eg sulphur for acid mine drainage characterisation). • In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed. • Any assumptions behind modelling of selective mining units. • Any assumptions about correlation between variables. • Description of how the geological interpretation was used to control the resource estimates. • Discussion of basis for using or not using grade cutting or capping. • The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available.	• The resource estimation has been undertaken in Datamine StudioRM mining software. • The grade estimation is controlled by geological interpretation. Limonite and saprolite was estimated separately based on geological domain. Sample limonite estimated by limonite sample only and saprolite estimated by saprolite sample only. • Ordinary Kriging (OK) has been applied to estimate the grades, but for several minor grade estimated using Inverse Distance Square (IDS) due to the variogram can not be obtained. • Variography was analysed in flat elevation. • The grade was estimated into block model in flat elevation and returned to actual elevation after grade estimation. • Block model size is a half of borehole spacing. This block size is a rule of thumb to create block model. • The borehole spacing are 25 m × 25 m, 50 m × 50 m, 100 m × 100 m, and 200 m × 200 m. so, the parent cell of block model is created in three size depend on the borehole spacing. The three parents cell size are 12.5 m × 12.5 m, 25 m × 25 m, and 50 m × 50 m. Although the parent cell is different for each borehole spacing but the cell size is 12.5 m × 12.5 m to keep the block model volume is similar with the wireframe volume. • The searching volume is ellipse. Three searching volume was applied to interpolate the grades. First search ellipse as a main searching volume is 40 m × 40 m × 10 m. The second search

Criteria	JORC Code explanation	Comment
		ellipse is three times of first search ellipse and the third search ellipse is six times of first search ellipse. • Minimum sample for grade estimation is 3 and maximum is 5 for first search ellipse, while for second and third search ellipse use 3 and 8 as minimum and maximum sample. • Grade cutting was used to get better data population then get better variogram experimental to be modelled. • Swath plot was used to validate the grade in block model compare to the grade in sample. • Another validation is create sections to display grade in block model and borehole, then compare the distribution.
Moisture	• Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.	• Tonnages are stated on wet basis and dry basis. • Moisture content (MC) is an assumption. • Assumption MC for limonite is 35%, while saprolite is 30%.
Cut-off parameters	• The basis of the adopted cut-off grade(s) or quality parameters applied.	• Cut-off grade was applied to estimate the resources. • Consideration to define cut-off grade is the ore utilization. • Cut-off grade for limonite is 1 % Ni due to the utilization plan for High Pressure Acid Leach (HPAL). • Cut-off grade for saprolite is 1.2 % Ni due to the utilization plan for Rotary Kiln Electric Furnace (RKEF) and Blast Furnace (BF).
Mining factors or assumptions	• Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential mining methods, but the assumptions made regarding mining methods and parameters when estimating Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the mining assumptions made.	• Mining method in Tapunopaka is undertaken by open pit.

Criteria	JORC Code explanation	Comment
Metallurgical factors or assumptions	• The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential metallurgical methods, but the assumptions regarding metallurgical treatment processes and parameters made when reporting Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the metallurgical assumptions made.	• Saprolite will be processed using Blast Furnace. • Limonite will be processed using HPAL.
Environmental factors or assumptions	• Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfields project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported. Where these aspects have not been considered this should be reported with an explanation of the environmental assumptions made.	• Waste will be backfilled to the pit.
Bulk density	• Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples. • The bulk density for bulk material must have been measured by methods that adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit. • Discuss assumptions for bulk density estimates used in the evaluation process of the different materials.	• Density is an assumption. • Density for limonite assumed 1.8, while saprolite assumed 1.7
Classification	• The basis for the classification of the Mineral Resources into varying confidence categories. • Whether appropriate account has been taken of all relevant factors (ie relative confidence in tonnage/grade estimations, reliability of input data, confidence in continuity of geology and metal values, quality, quantity and distribution of the data).	• The mineral resources were estimated separately between limonite and saprolite. • Basis for mineral classification is Slope Regression (SR) from Ni estimated grade. • If SR ≥ 0.6, the resources classified as Measured. • If 0.2 ≤ SR < 0.6, the resource classified as Indicated.

Criteria	JORC Code explanation	Comment
	• Whether the result appropriately reflects the Competent Person's view of the deposit.	• If SR < 0.2, the resource classified as Inferred. • The classification based on SR has correlation with the borehole spacing. • SR ≥ 0.6 has correlation with borehole spacing 25 m. • SR 0.2 - 0.6 has correlation with borehole spacing 50 m. • SR < has correlation with borehole spacing 100 m and 200 m.
Audits or reviews	• The results of any audits or reviews of Mineral Resource estimates.	• The resource estimate not reviewed yet.
Discussion of relative accuracy/ confidence	• Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors that could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	•

Table 1 - JORC Code, 2012 Edition

Section 4 Estimation and Reporting of Ore Reserves of **Tapunopaka Prospect**

Criteria	JORC Code explanation	Comment
Mineral Resource estimate for conversion to Ore Reserves	• Description of the Mineral Resource estimate used as a basis for the conversion to an Ore Reserve. • Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Ore Reserves.	• Mineral resources model are estimated by Geomin (ANTAM's exploration unit). • The measured and indicated nickel resources are inclusive of mineral resources • Ore reserves estimated are classified based on measured and indicated resources into proved and probable ore reserves • Ore reserve estimate for nickel laterite is reported into Limonite and saprolite ore
Site visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• The Competent Person visited Tapunopaka regularly between in 2013-2019
Study status	• The type and level of study undertaken to enable Mineral Resources to be converted to Ore Reserves.Nature of the data used and of any assumptions made. • The Code requires that a study to at least Pre-Feasibility Study level has been undertaken to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable, and that material Modifying Factors have been considered.	• Tapunopaka nickel deposit is a brownfield expansion of existing operation • Updated Feasibility study has been done in 2010
Cut-off parameters	• The basis of the cut-off grade(s) or quality parameters applied.	• Ni > 1.0 % is the cut-off grade applied for Limonite ore • Only limonite ore is mined for Tapunopaka, because ther is still no supply plan for the saprolite ore
Mining factors or assumptions	• The method and assumptions used as reported in the Pre-Feasibility or Feasibility Study to convert the Mineral Resource to an Ore Reserve (i.e. either by application of appropriate factors by optimisation or by preliminary or detailed design). • The choice, nature and appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc.	• Pit optimization with industry standard software were undertaken. This optimisation utilised the Mineral Resources model together with cost, revenue, and mining parameter inputs. As a result, optimized block model were exported from the software. • During the above process, inferred Mineral Resources were excluded from pit optimization"

Criteria	JORC Code explanation	Comment
	• The assumptions made regarding geotechnical parameters (eg pit slopes, stope sizes, etc), grade control and pre-production drilling. • The major assumptions made and Mineral Resource model used for pit and stope optimisation (if appropriate). • The mining dilution factors used. • In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed. • The mining recovery factors used. • Any minimum mining widths used. • Description of how the geological interpretation was used to control the resource estimates. • The manner in which Inferred Mineral Resources are utilised in mining studies and the sensitivity of the outcome to their inclusion. • The infrastructure requirements of the selected mining methods.	• Conventional mining methods (truck and shovel) will be utilized based on existing mine operation at Tapunopaka Mine.. • The geotechnical parameters have been applied based on updated geotechnical studies in 2018. • Assumed from existing production data • Mining Dilution used is 3 % • Mining Recovery used is 93 % • Minimum mining width used is 12.5 m • Inferred are not utilized • Requires access road, ore stockyard, waste dump, settling pond, Office, etc. • Tapunopaka already have all the infrastructures required.
Metallurgical factors or assumptions	• The metallurgical process proposed and the appropriateness of that process to the style of mineralisation. • Whether the metallurgical process is well-tested technology or novel in nature. • The nature, amount and representativeness of metallurgical test work undertaken, the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied. • Any assumptions or allowances made for deleterious elements. • The existence of any bulk sample or pilot scale test work and the degree to which such samples are considered representative of the orebody as a whole. • For minerals that are defined by a specification, has the ore reserve estimation been based on the appropriate mineralogy to meet the specifications?	• Based on the mineral resources estimation data, Tapunopaka ore is meet the grade requirement for the proposed plant • Antam has proposed HPAL Plant to process Tapunopaka ore. • HPAL is a proven technology and will be adopted to process tapunopaka's ore • The ore meets the plant requirement • Antam only analyze 12 elements (Ni, Fe, SiO2, MgO , Co, CaO, Al2O3, Cr2O3, MnO, P2O5, SO3, TiO2) • Sample will be prepared to do hydrometallurgical test • Yes, based on geochemical data, Tapunopaka ore meet plant ore specification
Environmental	• The status of studies of potential environmental impacts of the mining and processing operation. Details of waste rock characterisation and the consideration of potential sites, status of design options considered and, where applicable, the status of approvals for process residue storage and waste dumps should be reported.	• Environmental stucies (AMDAL) based on Indonesia's Environmental Regulation has been done and approved by Government.

Criteria	JORC Code explanation	Comment
Infrastructure	• The existence of appropriate infrastructure: availability of land for plant development, power, water, transportation (particularly for bulk commodities), labour, accommodation; or the ease with which the infrastructure can be provided, or accessed.	• Yes, it is already appropriate
Costs	• The derivation of, or assumptions made, regarding projected capital costs in the study. • The methodology used to estimate operating costs. • Allowances made for the content of deleterious elements. • The source of exchange rates used in the study. • Derivation of transportation charges. • The basis for forecasting or source of treatment and refining charges, penalties for failure to meet specification, etc. • The allowances made for royalties payable, both Government and private.	• Tapunopaka MIne is an on going operation, sustain capital cost is proposed regularly by the operation • Operating cost were estimated based on Tapunopaka historical production data • No deleterious element has been analyzed • Exchange rates obtained from assumption made in Antam's Annual Work Plan & Budget • Transportation costs were based on existing operation data • Assumed from existing production data • The allowances have been made for royalties to the government
Revenue factors	• The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc. • The derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.	• Metal price assumptions based on Antam's Long Term Plan 2019-2024 • Metal price based on Antam's Long Term Plan 2019-2024
Market assessment	• The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future. • A customer and competitor analysis along with the identification of likely market windows for the product. • Price and volume forecasts and the basis for these forecasts. • For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.	• Ore reserves estimation already based on Antam's future plan in which will absorb ore optimally • Antam delivers products aligned with its Mineral Resources and Ore Reserves which are successfully competed with nickel products supplied by other companies • Forecast has been made by Antam's budgeting team • Antam delivers products aligned with its Mineral Resources and Ore Reserves, these products have changed over time and successfully meet the requirement for ore supply
Economic	• The inputs to the economic analysis to produce the net present value (NPV) in the study, the source and confidence of these economic inputs including estimated inflation, discount rate, etc.	• Economic inputs are generated internally at Antam. The detail of this process is commercially sensitive and is not disclosed • Sensitivity has been made by various scenario

Criteria	JORC Code explanation	Comment
	• NPV ranges and sensitivity to variations in the significant assumptions and inputs.	
Social	• The status of agreements with key stakeholders and matters leading to social licence to operate.	• The Tapunopaka mine is part of Antam's Southeast Sulawesi Mining License (IUP) that have been granted based on Mineral and Coal Mining Regulation of 2009. Any necessary license regarding environmental and social also have been obtained
Other	• To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves: • Any identified material naturally occurring risks. • The status of material legal agreements and marketing arrangements. • The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect that all necessary Government approvals will be received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third party on which extraction of the reserve is contingent.	• The risks has been analyzed in Antam's Long Term Plan 2019-2024 • Both has been performed • No issues regarding to the mineral tenement status & government and statutory approvals.
Classification	• The basis for the classification of the Ore Reserves into varying confidence categories. • Whether the result appropriately reflects the Competent Person's view of the deposit. • The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).	• All measured mineral resources have been convert into Proved Ore Reserves, there is no consideration yet to put some proportion of measured mineral resources to be converted into probable ore reserve • The competent person satisfy that the Ore Reserves classification reflects the outcome of technical and economical studies • The classification of proven and probable ore reserves is based on the confidence categories of measured and indicated resources. The ore reseves for Tapunopaka consist of 65% Proved Reserves and 35% Probable Reserves
Audits or reviews	• The results of any audits or reviews of Mineral Reserve estimates.	• The ore reserves estimate have not been reviewed yet
Discussion of relative accuracy/ confidence	• Where appropriate a statement of the relative accuracy and confidence level in the Ore Reserve estimate using an approach or procedure deemed appropriate by the	• Data accuracy could be improved by conducting robust operation monitoring

Criteria	JORC Code explanation	Comment
	Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage. • It is recognised that this may not be possible or appropriate in all circumstances. These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	• Annual Mining Plan reviewed by comparing with ANTAM's Annual Work Plan & Budget • Commodity price, mining cost, and government's regulation give the biggest impact for reserves estimation.. • Mining reconciliation have been conducted regularly to compare mine plan vs actual production.

Table 1 - JORC Code, 2012 Edition

Section 3 Estimation and Reporting of Mineral Resources of **Bahubulu Prospect**

Criteria	JORC Code explanation	Comment
Database integrity	• Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes. • Data validation procedures used	• Inputing data system and data storage development makes the database more reliable. • Data (collar, lithology, assay) input use application developed by Geomin Unit of PT ANTAM in Microsoft Access has automatic function to create information such as borehole interception (FROM/TO), sample number, etc. to avoid mistype. • Data for resource estimation are from database division which is collected from exploration division. • The database is validated by exploration division as first validation step when data collection, then validated by database division prior to stored and managed. • Data from database division then validated by resource estimation division prior to be processed. • The data validation such as validate the collar, validate the borehole interception, and validate the assay.
Site visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• Competent Person not visited yet the prospect due to there is no exploration activity at the moment.
Geological interpretation	• Confidence in (or conversely, the uncertainty of) the geological interpretation of the mineral deposit. • Nature of the data used and of any assumptions made. • The effect, if any, of alternative interpretations on Mineral Resource estimation. • The use of geology in guiding and controlling Mineral Resource estimation. • The factors affecting continuity both of grade and geology.	• Geological interpretation has been undertaked in Datamine StudioRM mining software. • Geological interpretation based on geological domain (overburden, limonite, saprolite, and bedrock). • The geological domain was crosschecked by Explonatory Data Analysis. • Most of the old database does not have lithology information, so the geological domain is defined using assay (Ni, Fe, MgO, and SiO_2) by create vertical profile and checked by ternary diagram. • No alternative interpretation. • Each geological domain model is built in three dimensions.

Criteria	JORC Code explanation	Comment
		• Grade estimation for limonite and saprolite was estimated separately. • Boundary of laterite is a limit of geological continuity.
Dimensions	• The extent and variability of the Mineral Resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.	• The area of laterite is about 1,940 Ha. • The depth of laterite below surface is 0.6 m in average.
Estimation and modelling techniques	• The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domaining, interpolation parameters and maximum distance of extrapolation from data points. If a computer assisted estimation method was chosen include a description of computer software and parameters used. • The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data. • The assumptions made regarding recovery of by-products. • Estimation of deleterious elements or other non-grade variables of economic significance (eg sulphur for acid mine drainage characterisation). • In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed. • Any assumptions behind modelling of selective mining units. • Any assumptions about correlation between variables. • Description of how the geological interpretation was used to control the resource estimates. • Discussion of basis for using or not using grade cutting or capping. • The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available.	• The resource estimation has been undertaken in Datamine StudioRM mining software. • The grade estimation is controlled by geological interpretation. Limonite and saprolite was estimated separately based on geological domain. Sample limonite estimated by limonite sample only and saprolite estimated by saprolite sample only. • Ordinary Kriging (OK) has been applied to estimate the grades, but for several minor grade estimated using Inverse Distance Square (IDS) due to the variogram can not be obtained. • Variography was analysed in flat elevation. • The grade was estimated into block model in flat elevation and returned to actual elevation after grade estimation. • Block model size is a half of borehole spacing. This block size is a rule of thumb to create block model. • The borehole spacing are 25 m × 25 m, 50 m × 50 m, 100 m × 100 m, and 200 m × 200 m. so, the parent cell of block model is created in three size depend on the borehole spacing. The three parents cell size are 12.5 m × 12.5 m, 25 m × 25 m, and 50 m × 50 m. Although the parent cell is different for each borehole spacing but the cell size is 12.5 m × 12.5 m to keep the block model volume is similar with the wireframe volume. • The searching volume is ellipse. Three searching volume was applied to interpolate the grades. First search ellipse as a main searching volume is 40 m × 40 m × 10 m. The second search

Criteria	JORC Code explanation	Comment
		ellipse is three times of first search ellipse and the third search ellipse is six times of first search ellipse. • Minimum sample for grade estimation is 3 and maximum is 5 for first search ellipse, while for second and third search ellipse use 3 and 8 as minimum and maximum sample. • Grade cutting was used to get better data population then get better variogram experimental to be modelled. • Swath plot was used to validate the grade in block model compare to the grade in sample. • Another validation is create sections to display grade in block model and borehole, then compare the distribution.
Moisture	• Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.	• Tonnages are stated on wet basis and dry basis. • Moisture content (MC) is an assumption. • Assumption MC for limonite is 35%, while saprolite is 30%.
Cut-off parameters	• The basis of the adopted cut-off grade(s) or quality parameters applied.	• Cut-off grade was applied to estimate the resources. • Consideration to define cut-off grade is the ore utilization. • Cut-off grade for limonite is 1.2 % Ni due to the utilization plan for Blast Furnace (BF). • Cut-off grade for saprolite is 1.2 % Ni due to the utilization plan for Rotary Kiln Electric Furnace (RKEF) and Blast Furnace (BF).
Mining factors or assumptions	• Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential mining methods, but the assumptions made regarding mining methods and parameters when estimating Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the mining assumptions made.	• Mining method in Bahubulu will be open pit.

Criteria	JORC Code explanation	Comment
Metallurgical factors or assumptions	• The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential metallurgical methods, but the assumptions regarding metallurgical treatment processes and parameters made when reporting Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the metallurgical assumptions made.	• Saprolite will be sent to Pomalaa and processed as ferro nickel. • Limonite and low grade saprolite will be processed as nickel pig iron.
Environmental factors or assumptions	• Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfields project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported. Where these aspects have not been considered this should be reported with an explanation of the environmental assumptions made.	• Waste will be backfilled to the pit.
Bulk density	• Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples. • The bulk density for bulk material must have been measured by methods that adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit. • Discuss assumptions for bulk density estimates used in the evaluation process of the different materials.	• Density is an assumption. • Density for limonite assumed 1.8, while saprolite assumed 1.7
Classification	• The basis for the classification of the Mineral Resources into varying confidence categories. • Whether appropriate account has been taken of all relevant factors (ie relative confidence in tonnage/grade estimations, reliability of input data, confidence in continuity of geology and metal values, quality, quantity and distribution of the data).	• The mineral resources were estimated separately between limonite and saprolite. • Basis for mineral classification is Slope Regression (SR) from Ni estimated grade. • If SR ≥ 0.6, the resources classified as Measured. • If 0.2 ≤ SR < 0.6, the resource classified as Indicated.

Criteria	JORC Code explanation	Comment
	• Whether the result appropriately reflects the Competent Person's view of the deposit.	• If SR < 0.2, the resource classified as Inferred. • The classification based on SR has correlation with the borehole spacing. • SR ≥ 0.6 has correlation with borehole spacing 25 m. • SR 0.2 - 0.6 has correlation with borehole spacing 50 m. • SR < has correlation with borehole spacing 100 m and 200 m.
Audits or reviews	• The results of any audits or reviews of Mineral Resource estimates.	• The resource estimate not reviewed yet.
Discussion of relative accuracy/ confidence	• Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors that could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	• Relative accuracy/confidence of resource estimate can not compare yet with the production due to the Bahubulu prospect is not mined yet. •

Table 1 - JORC Code, 2012 Edition

Section 4 Estimation and Reporting of Ore Reserves of **Bahubulu Prospect**

Criteria	JORC Code explanation	Comment
Mineral Resource estimate for conversion to Ore Reserves	• Description of the Mineral Resource estimate used as a basis for the conversion to an Ore Reserve. • Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Ore Reserves.	• Mineral resources model are estimated by Geomin (ANTAM's exploration unit). • The measured and indicated nickel resources are inclusive of mineral resources • Ore reserves estimated are classified based on measured and indicated resources into proved and probable ore reserves • Ore reserve estimate for nickel laterite is reported into Limonite and saprolite ore
Site visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• The Competent Person visited Bahubulu in 2019
Study status	• The type and level of study undertaken to enable Mineral Resources to be converted to Ore Reserves.Nature of the data used and of any assumptions made. • The Code requires that a study to at least Pre-Feasibility Study level has been undertaken to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable, and that material Modifying Factors have been considered.	• Bahubulu nickel deposit is a greenfield project, yet it is part of the prospect in Antam's Southeast Sulawesi Nickel Unit. • Feasibility study has been done in 2010
Cut-off parameters	• The basis of the cut-off grade(s) or quality parameters applied.	• Ni > 1.2 % is the cut-off grade applied for Limonite ore • Ni > 1.5 % is the cut-off grade applied for Saprolite ore
Mining factors or assumptions	• The method and assumptions used as reported in the Pre-Feasibility or Feasibility Study to convert the Mineral Resource to an Ore Reserve (i.e. either by application of appropriate factors by optimisation or by preliminary or detailed design). • The choice, nature and appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc. • The assumptions made regarding geotechnical parameters (eg pit slopes, stope sizes, etc), grade control and pre-production drilling.	• Pit optimization with industry standard software were undertaken. This optimisation utilised the Mineral Resources model together with cost, revenue, and mining parameter inputs. As a result, optimized block model were exported from the software. • During the above process, inferred Mineral Resources were excluded from pit optimization" • Conventional mining methods (truck and shovel) will be utilised based on existing

Criteria	JORC Code explanation	Comment
	• The major assumptions made and Mineral Resource model used for pit and stope optimisation (if appropriate). • The mining dilution factors used. • In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed. • The mining recovery factors used. • Any minimum mining widths used. • Description of how the geological interpretation was used to control the resource estimates. • The manner in which Inferred Mineral Resources are utilised in mining studies and the sensitivity of the outcome to their inclusion. • The infrastructure requirements of the selected mining methods.	mine operation at Antam's Southeast Sulawesi Mine. • The geotechnical parameters have been applied based on geotechnical studies in Tapunopaka mine. • Assumed from existing production data in Tapunopaka • Mining Dilution used is 3 % • Mining Recovery used is 93 % • Minimum mining width used is 12.5 m • Inferred are not utilized • No infrastructure development yet in Bahubulu, so it requires access road, ore stockyard, waste dump, Grizzly Screening, settling pond, Office, etc
Metallurgical factors or assumptions	• The metallurgical process proposed and the appropriateness of that process to the style of mineralisation. • Whether the metallurgical process is well-tested technology or novel in nature. • The nature, amount and representativeness of metallurgical test work undertaken, the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied. • Any assumptions or allowances made for deleterious elements. • The existence of any bulk sample or pilot scale test work and the degree to which such samples are considered representative of the orebody as a whole. • For minerals that are defined by a specification, has the ore reserve estimation been based on the appropriate mineralogy to meet the specifications?	• Based on the mineral resources estimation data, Bahubulu ore is meet the grade requirement for Feni Pomalaa and NPI Blast Furnace plant that will be build in North Maluku. • Pomalaa FeNi Plant is well tested and have been operated for 30 years • NPI Blast Furnace is a proven technology and will be adopted to process tapunopaka's ore" • The ore meets the plant requirement • Antam only analyze 6 elements in Bahubulu prospect (Ni, Fe, SiO2, MgO , Co, CaO) • The Feni Pomalaa plant is a proven operation foe more than 30 years. No need to do any pilot test. • The NPI Blast Furnace is a proven technology. Based on geochemical data, Bahubulu ore meet the ore specification needed for NPI Blast Furnace" • Yes, based on geochemical data,Bahubulu ore meet Feni Plant and NPI Blast Furnace ore specification
Environmental	• The status of studies of potential environmental impacts of the mining and processing operation. Details of waste rock characterisation and the consideration of	• Environmental stucies (AMDAL) based on Indonesia's Environmental Regulation has been done and approved by Government

Criteria	JORC Code explanation	Comment
	potential sites, status of design options considered and, where applicable, the status of approvals for process residue storage and waste dumps should be reported.	
Infrastructure	• The existence of appropriate infrastructure: availability of land for plant development, power, water, transportation (particularly for bulk commodities), labour, accommodation; or the ease with which the infrastructure can be provided, or accessed.	• Infrastructure will be built to support Bahubulu project.
Costs	• The derivation of, or assumptions made, regarding projected capital costs in the study. • The methodology used to estimate operating costs. • Allowances made for the content of deleterious elements. • The source of exchange rates used in the study. • Derivation of transportation charges. • The basis for forecasting or source of treatment and refining charges, penalties for failure to meet specification, etc. • The allowances made for royalties payable, both Government and private.	• Capital cost will be estimated based on Antam's Long Term Plan • Operating cost will be estimated based on Tapunopaka historical production data • No deleterious element has been analyzed • Exchange rates obtained from assumption made in Antam's Annual Work Plan & Budget • Transportation costs were based on existing operation data • Assumed from existing production data • The allowances have been made for royalties to the government
Revenue factors	• The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc. • The derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.	• Metal price assumptions based on Antam's Long Term Plan 2019-2024 • Metal price based on Antam's Long Term Plan 2019-2024
Market assessment	• The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future. • A customer and competitor analysis along with the identification of likely market windows for the product. • Price and volume forecasts and the basis for these forecasts. • For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.	• Ore reserves estimation already based on Antam's future plan in which will absorb ore optimally • Antam delivers products aligned with its Mineral Resources and Ore Reserves which are successfully competed with nickel products supplied by other companies • Forecast has been made by Antam's budgeting team • Antam delivers products aligned with its Mineral Resources and Ore Reserves, these products have changed over time and successfully meet the requirement for ore supply
Economic	• The inputs to the economic analysis to produce the net present value (NPV) in the study, the	• Economic inputs are generated internally at Antam. The detail of this process is

Criteria	JORC Code explanation	Comment
	source and confidence of these economic inputs including estimated inflation, discount rate, etc. • NPV ranges and sensitivity to variations in the significant assumptions and inputs.	commercially sensitive and is not disclosed • Sensitivity has been made by various scenario
Social	• The status of agreements with key stakeholders and matters leading to social licence to operate.	• The Bahubulu mine is part of Antam's Southeast Sulawesi Mining License (IUP) that have been granted based on Mineral and Coal Mining Regulation of 2009.
Other	• To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves: • Any identified material naturally occurring risks. • The status of material legal agreements and marketing arrangements. • The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect that all necessary Government approvals will be received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third party on which extraction of the reserve is contingent.	• The risks has been analyzed in Antam's Long Term Plan 2019-2024 • Both has been performed • No issues regarding to the mineral tenement status & government and statutory approvals.
Classification	• The basis for the classification of the Ore Reserves into varying confidence categories. • Whether the result appropriately reflects the Competent Person's view of the deposit. • The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).	• All measured mineral resources have been convert into Proved Ore Reserves, there is no consideration yet to put some proportion of measured mineral resources to be converted into probable ore reserve • The competent person satisfy that the Ore Reserves classification reflects the outcome of technical and economical studies • The classification of proven and probable ore reserves is based on the confidence categories of measured and indicated resources. The ore reseves for Bahubulu 100% is Probable Reserves
Audits or reviews	• The results of any audits or reviews of Mineral Reserve estimates.	• The ore reserves estimate have not been reviewed yet
Discussion of relative accuracy/ confidence	• Where appropriate a statement of the relative accuracy and confidence level in the Ore Reserve estimate using an approach or procedure deemed appropriate by the	• Data accuracy could be improved by conducting robust operation monitoring

Criteria	JORC Code explanation	Comment
	Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage. • It is recognised that this may not be possible or appropriate in all circumstances. These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	• Annual Mining Plan reviewed by comparing with ANTAM's Annual Work Plan & Budget • Commodity price, mining cost, and government's regulation give the biggest impact for reserves estimation.. • Mining reconciliation have been conducted regularly to compare mine plan vs actual production.

Table 1 - JORC Code, 2012 Edition

Section 3 Estimation and Reporting of Mineral Resources of **Gag Prospect**

Criteria	JORC Code explanation	Comment
Database integrity	• Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes. • Data validation procedures used	• Inputing data system and data storage development makes the database more reliable. • Data (collar, lithology, assay) input use application developed by Geomin Unit of PT ANTAM in Microsoft Access has automatic function to create information such as borehole interception (FROM/TO), sample number, etc. to avoid mistype. • Data for resource estimation are from database division which is collected from exploration division. • The database is validated by exploration division as first validation step when data collection, then validated by database division prior to stored and managed. • Data from database division then validated by resource estimation division prior to be processed. • The data validation such as validate the collar, validate the borehole interception, and validate the assay.
Site visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• Site visit have been conducted several times by Competent Person. • Competent person discussed with exploration team about database when visit the site.
Geological interpretation	• Confidence in (or conversely, the uncertainty of) the geological interpretation of the mineral deposit. • Nature of the data used and of any assumptions made. • The effect, if any, of alternative interpretations on Mineral Resource estimation. • The use of geology in guiding and controlling Mineral Resource estimation. • The factors affecting continuity both of grade and geology.	• Geological interpretation has been undertaked in Datamine StudioRM mining software. • Geological interpretation based on geological domain (overburden, limonite, saprolite, and bedrock). • The geological domain was crosschecked by Explonatory Data Analysis. • Most of the old database does not have lithology information, so the geological domain is defined using assay (Ni, Fe, MgO, and SiO_2) by create vertical profile and checked by ternary diagram. • No alternative interpretation. • Each geological domain model is built in three dimensions.

Criteria	JORC Code explanation	Comment
		• Grade estimation for limonite and saprolite was estimated separately. • Boundary of laterite is a limit of geological continuity.
Dimensions	• The extent and variability of the Mineral Resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.	• The area of laterite is about 3,100 Ha. • The depth of laterite below surface is 1.6 m in average.
Estimation and modelling techniques	• The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domaining, interpolation parameters and maximum distance of extrapolation from data points. If a computer assisted estimation method was chosen include a description of computer software and parameters used. • The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data. • The assumptions made regarding recovery of by-products. • Estimation of deleterious elements or other non-grade variables of economic significance (eg sulphur for acid mine drainage characterisation). • In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed. • Any assumptions behind modelling of selective mining units. • Any assumptions about correlation between variables. • Description of how the geological interpretation was used to control the resource estimates. • Discussion of basis for using or not using grade cutting or capping. • The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available.	• The resource estimation has been undertaken in Datamine StudioRM mining software. • The grade estimation is controlled by geological interpretation. Limonite and saprolite was estimated separately based on geological domain. Sample limonite estimated by limonite sample only and saprolite estimated by saprolite sample only. • Ordinary Kriging (OK) has been applied to estimate the grades, but for several minor grade estimated using Inverse Distance Square (IDS) due to the variogram can not be obtained. • Variography was analysed in flat elevation. • The grade was estimated into block model in flat elevation and returned to actual elevation after grade estimation. • Block model size is a half of borehole spacing. This block size is a rule of thumb to create block model. • The borehole spacing are 25 m × 25 m, 50 m × 50 m, 100 m × 100 m, and 200 m × 200 m. so, the parent cell of block model is created in three size depend on the borehole spacing. The three parents cell size are 12.5 m × 12.5 m, 25 m × 25 m, and 50 m × 50 m. Although the parent cell is different for each borehole spacing but the cell size is 12.5 m × 12.5 m to keep the block model volume is similar with the wireframe volume. • The searching volume is ellipse. Three searching volume was applied to interpolate the grades. First search ellipse as a main searching volume is 40 m × 40 m × 10 m. The second search

Criteria	JORC Code explanation	Comment
		ellipse is three times of first search ellipse and the third search ellipse is six times of first search ellipse. • Minimum sample for grade estimation is 3 and maximum is 5 for first search ellipse, while for second and third search ellipse use 3 and 8 as minimum and maximum sample. • Grade cutting was used to get better data population then get better variogram experimental to be modelled. • Swath plot was used to validate the grade in block model compare to the grade in sample. • Another validation is create sections to display grade in block model and borehole, then compare the distribution.
Moisture	• Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.	• Tonnages are stated on wet basis and dry basis. • Moisture content was determined by analysis in internal assay laboratorium.
Cut-off parameters	• The basis of the adopted cut-off grade(s) or quality parameters applied.	• Cut-off grade was applied to estimate the resources. • Consideration to define cut-off grade is the ore utilization. • Cut-off grade for limonite is 1.2 % Ni due to the utilization plan of low grade ore management. • Cut-off grade for saprolite is 1.5 % Ni due to the utilization plan for Rotary Kiln Electric Furnace (RKEF).
Mining factors or assumptions	• Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential mining methods, but the assumptions made regarding mining methods and parameters when estimating Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the mining assumptions made.	• Mining method in Gag is undertaken by open pit.

Criteria	JORC Code explanation	Comment
Metallurgical factors or assumptions	• The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential metallurgical methods, but the assumptions regarding metallurgical treatment processes and parameters made when reporting Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the metallurgical assumptions made.	• Saprolite will be processed as ferro nickel. • Limonite will be stocked as Low Grade Ore Management (LGOM) program.
Environmental factors or assumptions	• Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfields project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported. Where these aspects have not been considered this should be reported with an explanation of the environmental assumptions made.	• Waste will be backfilled to the pit.
Bulk density	• Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples. • The bulk density for bulk material must have been measured by methods that adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit. • Discuss assumptions for bulk density estimates used in the evaluation process of the different materials.	• Density is determined by dividing the core weight with the volume of core barrel. • Density also determined using Archimedes principle. • The average of density value of each domain is inputted to block model.
Classification	• The basis for the classification of the Mineral Resources into varying confidence categories. • Whether appropriate account has been taken of all relevant factors (ie relative confidence in tonnage/grade estimations, reliability of input data, confidence in continuity of geology and metal values, quality, quantity and distribution of the data).	• Basis for mineral classification is Slope Regression (SR) from Ni estimated grade. • If SR ≥ 0.6, the resources classified as Measured. • If 0.2 ≤ SR < 0.6, the resource classified as Indicated. • If SR < 0.2, the resource classified as Inferred.

Criteria	JORC Code explanation	Comment
	• Whether the result appropriately reflects the Competent Person's view of the deposit.	• The classification based on SR has correlation with the borehole spacing. • SR ≥ 0.6 has correlation with borehole spacing 25 m. • SR 0.2 - 0.6 has correlation with borehole spacing 50 m. • SR < has correlation with borehole spacing 100 m and 200 m.
Audits or reviews	• The results of any audits or reviews of Mineral Resource estimates.	• The resource estimate not reviewed yet.
Discussion of relative accuracy/ confidence	• Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors that could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	•

Table 1 - JORC Code, 2012 Edition

Section 4 Estimation and Reporting of Ore Reserves of **Gag Prospect**

Criteria	JORC Code explanation	Comment
Mineral Resource estimate for conversion to Ore Reserves	• Description of the Mineral Resource estimate used as a basis for the conversion to an Ore Reserve. • Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Ore Reserves.	• Mineral resources model are estimated by Geomin (ANTAM's exploration unit). • The measured and indicated nickel resources are inclusive of mineral resources • Ore reserves estimated are classified based on measured and indicated resources into proved and probable ore reserves • Ore reserve estimate for nickel laterite is reported into Limonite and saprolite ore
Site visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• The Competent Person visited Gag regularly between 2018-2019
Study status	• The type and level of study undertaken to enable Mineral Resources to be converted to Ore Reserves.Nature of the data used and of any assumptions made. • The Code requires that a study to at least Pre-Feasibility Study level has been undertaken to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable, and that material Modifying Factors have been considered.	• Gag nickel deposit is a brownfield expansion of existing operation • Updated Feasibility study has been done in 2019
Cut-off parameters	• The basis of the cut-off grade(s) or quality parameters applied.	• Ni > 1.5 % is the cut-off grade applied for both Limonite and Saprolite ore
Mining factors or assumptions	• The method and assumptions used as reported in the Pre-Feasibility or Feasibility Study to convert the Mineral Resource to an Ore Reserve (i.e. either by application of appropriate factors by optimisation or by preliminary or detailed design). • The choice, nature and appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc. • The assumptions made regarding geotechnical parameters (eg pit slopes, stope sizes, etc), grade control and pre-production drilling.	• Pit optimization with industry standard software were undertaken. This optimisation utilised the Mineral Resources model together with cost, revenue, and mining parameter inputs. As a result, optimized block model were exported from the software. • During the above process, inferred Mineral Resources were excluded from pit optimization" • Conventional mining methods (truck and shovel) will be utilized based on existing mine operation at Gag mine..

Criteria	JORC Code explanation	Comment
	• The major assumptions made and Mineral Resource model used for pit and stope optimisation (if appropriate). • The mining dilution factors used. • In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed. • The mining recovery factors used. • Any minimum mining widths used. • Description of how the geological interpretation was used to control the resource estimates. • The manner in which Inferred Mineral Resources are utilised in mining studies and the sensitivity of the outcome to their inclusion. • The infrastructure requirements of the selected mining methods.	• The geotechnical parameters have been applied based on updated geotechnical studies in 2012 and 2019. • Assumed from existing production data • Mining Dilution used is 3 % • Mining Recovery used is 93 % • Minimum mining width used is 12.5 m • Inferred are not utilized • Requires access road, ore stockyard, waste dump, settling pond, Office, etc. • Gag already have all the infrastructures required.
Metallurgical factors or assumptions	• The metallurgical process proposed and the appropriateness of that process to the style of mineralisation. • Whether the metallurgical process is well-tested technology or novel in nature. • The nature, amount and representativeness of metallurgical test work undertaken, the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied. • Any assumptions or allowances made for deleterious elements. • The existence of any bulk sample or pilot scale test work and the degree to which such samples are considered representative of the orebody as a whole. • For minerals that are defined by a specification, has the ore reserve estimation been based on the appropriate mineralogy to meet the specifications?	• Based on the mineral resources estimation data, Gag ore is meet the grade requirement for the proposed supply plan • Gag will supply ore for Feni plant and domestic market" • Gag's Feni Plant is will be build in West Papua region • The ore meets the plant requirement • Antam only analyze 12 elements (Ni, Fe, SiO2, MgO , Co, CaO, Al2O3, Cr2O3, MnO, P2O5, SO3, TiO2) • Gag's Feni Project will conduct metalurgical test for pilot scale. • Yes, based on geochemical data, Gag ore meet Feni Plant and domestic market
Environmental	• The status of studies of potential environmental impacts of the mining and processing operation. Details of waste rock characterisation and the consideration of potential sites, status of design options considered and, where applicable, the status of approvals for process residue storage and waste dumps should be reported.	• Environmental stucies (AMDAL) based on Indonesia's Environmental Regulation has been done and approved by Government.
Infrastructure	• The existence of appropriate infrastructure: availability of land for plant development, power, water, transportation (particularly for	• Yes, it is already appropriate

Criteria	JORC Code explanation	Comment
	bulk commodities), labour, accommodation; or the ease with which the infrastructure can be provided, or accessed.	
Costs	• The derivation of, or assumptions made, regarding projected capital costs in the study. • The methodology used to estimate operating costs. • Allowances made for the content of deleterious elements. • The source of exchange rates used in the study. • Derivation of transportation charges. • The basis for forecasting or source of treatment and refining charges, penalties for failure to meet specification, etc. • The allowances made for royalties payable, both Government and private.	• Gag MIne is an on going operation, sustain capital cost is proposed regularly by the operation • Operating cost were estimated based on Gag historical production data • No deleterious element has been analyzed • Exchange rates obtained from assumption made in Antam's Annual Work Plan & Budget • Transportation costs were based on existing operation data • Assumed from existing production data • The allowances have been made for royalties to the government
Revenue factors	• The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc. • The derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.	• Metal price assumptions based on Antam's Long Term Plan 2019-2024 • Metal price based on Antam's Long Term Plan 2019-2024
Market assessment	• The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future. • A customer and competitor analysis along with the identification of likely market windows for the product. • Price and volume forecasts and the basis for these forecasts. • For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.	• Ore reserves estimation already based on Antam's future plan in which will absorb ore optimally • Antam delivers products aligned with its Mineral Resources and Ore Reserves which are successfully competed with nickel products supplied by other companies • Forecast has been made by Antam's budgeting team • Antam delivers products aligned with its Mineral Resources and Ore Reserves, these products have changed over time and successfully meet the requirement for ore supply
Economic	• The inputs to the economic analysis to produce the net present value (NPV) in the study, the source and confidence of these economic inputs including estimated inflation, discount rate, etc. • NPV ranges and sensitivity to variations in the significant assumptions and inputs.	• Economic inputs are generated internally at Antam. The detail of this process is commercially sensitive and is not disclosed • Sensitivity has been made by various scenario

Criteria	JORC Code explanation	Comment
Social	• The status of agreements with key stakeholders and matters leading to social licence to operate.	• The Gag Island mine mining license is owned by Antam's subsidiary PT Gag Nikel PT Gag hold the Contract of Work (CoW).
Other	• To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves: • Any identified material naturally occurring risks. • The status of material legal agreements and marketing arrangements. • The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect that all necessary Government approvals will be received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third party on which extraction of the reserve is contingent.	• The risks has been analyzed in Antam's Long Term Plan 2019-2024 • Both has been performed • No issues regarding to the mineral tenement status & government and statutory approvals.
Classification	• The basis for the classification of the Ore Reserves into varying confidence categories. • Whether the result appropriately reflects the Competent Person's view of the deposit. • The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).	• All measured mineral resources have been convert into Proved Ore Reserves, there is no consideration yet to put some proportion of measured mineral resources to be converted into probable ore reserve • The competent person satisfy that the Ore Reserves classification reflects the outcome of technical and economical studies • The classification of proven and probable ore reserves is based on the confidence categories of measured and indicated resources. The ore reseves for Gag are consist of 17% Proved Reserves and 83% Probable Reserves
Audits or reviews	• The results of any audits or reviews of Mineral Reserve estimates.	• The ore reserves estimate have not been reviewed yet
Discussion of relative accuracy/ confidence	• Where appropriate a statement of the relative accuracy and confidence level in the Ore Reserve estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate,	• Data accuracy could be improved by conducting robust operation monitoring • Annual Mining Plan reviewed by comparing with ANTAM's Annual Work Plan & Budget • Commodity price, mining cost, and government's regulation give the biggest impact for reserves estimation..

Criteria	JORC Code explanation	Comment
	a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage. • It is recognised that this may not be possible or appropriate in all circumstances. These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	• Mining reconciliation have been conducted regularly to compare mine plan vs actual production.

Table 1 - JORC Code, 2012 Edition

Section 3 Estimation and Reporting of Mineral Resources of **Tayan IUP**

Criteria	JORC Code explanation	Commentary
Database integrity	• Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes. • Data validation procedures used.	• The database was thoroughly tested and validated and only pits with reliable data were reported in the Resources. • Resource estimation team validated the data regarding the collar, assay, and lithology into drillhole data. If there's any error, the data will be re-evaluated by comparing the database with exploration team's raw data. • Validating data has been conducted to avoid zone interspace and duplicate collar exploration test pit data and it has been verified by resource estimation team by comparing between geologist assessment and assay result. • The data validation such as validate the collar, Lidar topography, sample interval, sample logging description, and assay. • Duplicate collar of different test pit data was found in 195 of 47,633 (0.4% data) location of old test pits data (from 2005-2013). The duplicate test pits were excluded for resource estimation for further verification and validation. • Clarify and analyze between the total assay and raw data include laboratorium check. In addition, re-check supposed to be applied if necessary.
Site visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• Site visit has been done several times by competent person to capture the actual condition of the site, discussed with exploration team, and advisably proposed some improvement.
Geological interpretation	• Confidence in (or conversely, the uncertainty of) the geological interpretation of the mineral deposit. • Nature of the data used and of any assumptions made. • The effect, if any, of alternative interpretations on Mineral Resource estimation. • The use of geology in guiding and controlling Mineral Resource estimation. • The factors affecting continuity both of grade and geology.	• Sample checking were shown a good correlation. • Data acquisition in a whole prospected area were shown in a good continuity of bauxite thickness, the grade distribution was shown good homogeneity in the same mineralization domain. • The geological domain of mineralization is modeled from the surface mapping and petrography-mineralogy sample. The initial domain from exploration geologist then confirmed to geochemical distribution and test pit logging data in Exploratory Data Analysis. There are 3 domains defined to be separately estimated in resource modeling: - Domain 1: intermediate to mafic hosted rock bauxite (diorite, micro-diorite) - Domain 2: intermediate to felsic hosted rock bauxite (quartz-diorite, granodiorite) - Domain 3: meta-sediment • Depth of test pit data is correctly reported,

Criteria	JORC Code explanation	Commentary
		however some of the test pit elevation data were still incorrect elevation. The remaining error is corrected by adjusting to the latest Lidar data. • Lateritic boundary is generated using the bottom contour of each hill and it used to constraint the resource estimation area.
Dimensions	• The extent and variability of the Mineral Resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.	• The geometry, depth and distribution of bauxite ore are well constrained by close spacing test-pit and morphology topography. • The top and bottom of bauxite layer is determined by geologist in test pit logging process. The top of bauxite layer starting from changing of latosol interval (fine grain) to bauxite interval indicated by the presence of concretion. Bottom of bauxite is determined by the presence of clay material (kong). • The depth of bauxite top layer ranging from 2-3 meters with average thickness of overburden material ranging 3-3.5 meters.
Estimation and modelling techniques	• The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domaining, interpolation parameters and maximum distance of extrapolation from data points. If a computer assisted estimation method was chosen include a description of computer software and parameters used. • The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data. • The assumptions made regarding recovery of by-products. • Estimation of deleterious elements or other non-grade variables of economic significance (eg sulphur for acid mine drainage characterisation). • In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed. • Any assumptions behind modelling of selective mining units. • Any assumptions about correlation between variables.	• The resource modelling and estimation have been undertaken in Datamine studio RM software, statistical and geostatistical undertaken using Snowden Supervisor software. • Bauxite resources is estimated in washed bauxite, the concretion factor is the ratio between washed bauxite to crude bauxite in percent tonnage. Then it is estimated to every cell of block model to convert from crude bauxite into washed bauxite. • Washed bauxite samples were analysed with XRF methode for Al_2O_3, Fe_2O_3, T-SiO_2, TiO_2 and Wet analysis methode for R- SiO_2 in Antam's internal laboratory. The 5 elements then estimated to resource block model to obtain the grade distribution. • Grade distribution in resource model was estimated by kriging method in bauxite zone using raw data from test pit as input data. • Outlier data were top cut after statistically approaches have been applied. This approach was conducted to avoid overestimate calculation due to the outlier data. • Variography was analysed in top flatten of ore elevation. • Search distance in grade estimation was used the range of variography. The searching volume is ellipse, three searching volume was applied to

Criteria	JORC Code explanation	Commentary
	• Description of how the geological interpretation was used to control the resource estimates. • Discussion of basis for using or not using grade cutting or capping. • The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available.	interpolate the grades. First search ellipse as a main searching volume is 40 m × 40 m × 10 m. The second search ellipse is four times of first search ellipse and the third search ellipse is eight times of first search ellipse. • Minimum and maximum sample number for the first search ellipse are 2 and 4 respectively, for the second search ellipse are 3 and 8 respectively, and for the third search ellipse are 4 and 12 respectively. • Block model for resource estimation was calculated in 12.5 x 12.5 x 2 m of parent block size for the area with test pit spacing 25 x 25 meter and 50 x 50 m. While for area with test pit spacing equal and above 100 x 100 m was using 25 x 25 x 2 m parent block size. Although the parent block size is different according to test pit spacing, but the individual cell/subcell size is 12.5 x 12.5 x 2 m to maintain the accuracy of the volume following the layer wireframes. • The grade was estimated into block model in top flatten of ore elevation and returned to actual/true elevation after grade estimation. • Controlling boundary of resource estimation as geological domaining, boundary laterite, and top–bottom bauxite layer from testpit sample interval. • Compare and analyze the statistic resume such as mean, min, max, etc. • Block model validation by creating section to display grade in estimated block model and test pit, then comparing the appropriateness of grade distribution visually between actual and estimated grade. • Swath plot was used to validate the grade in block model compared to actual sample graphically. • Results of the estimation is always compared to previous estimation, then it is synchronized with actual mining production data in mining reconciliation.
Moisture	• Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.	• Tonnages are estimated both on wet and dry basis. • The average moisture content that used in Tayan resource estimation is approximately 15% based on Tayan Mining Block Test in 2009 and average moisture data from historical mine operation between 2014 to 2019.

Criteria	JORC Code explanation	Commentary
Cut-off parameters	• The basis of the adopted cut-off grade(s) or quality parameters applied.	• The basis cut-off grade(s) and quality parameters are applied to meet the requirement for Tayan Chemical Grade Alumina (CGA) plant bauxite feed and bauxite export specifications. The bauxite specification target are $Al_2O_3 \geq 47.8$ % and maximum 3.6 % of $RSiO_2$ for CGA plant, for export are $Al_2O_3 \geq 47.0$ % and $TSiO_2 \leq 9$ %. • The chemical cut-offs were based mainly on total alumina% (T-Al_2O_3) and reactive silica% (R-SiO_2) according to the mineralization domain as follows: Block AB: - Domain 1: $Al_2O_3 \geq 30$ - Domain 2: $Al_2O_3 \geq 33$ and $RSiO_2 < 8$ - Domain 3: $Al_2O_3 > 40$ and $RSiO_2 < 6$ Block CDE: $Al_2O_3 \geq 33$ and $RSiO_2 < 8$ Block MungguPasir: $RSiO_2 < 8$
Mining factors or assumptions	• Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential mining methods, but the assumptions made regarding mining methods and parameters when estimating Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the mining assumptions made.	• Lateritic bauxite deposits in west Kalimantan are typically shallow deposit with the depth of bauxite layer bottom approximately 6 to 12 meters from the surface. Open cast surface mining is the most suitable mining method to be applied for this type of deposit. Selective mining can be applied properly in shallow deposit to minimize mine dilution.
Metallurgical factors or assumptions	• The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential metallurgical methods, but the assumptions regarding metallurgical treatment processes and parameters made when reporting Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the metallurgical assumptions made.	• Based on detailed chemical analysis, reactive silica and available alumina data that applied in Cut-off Grade is possible to assess the metallurgical amenability of the bauxite. Tayan bauxite can be categorized as medium to high grade bauxite with medium to low silica content, it is suitable to be processed for chemical grade or smelter grade alumina by bayer process.

Criteria	JORC Code explanation	Commentary
Environmental factors or assumptions	• Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfields project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported. Where these aspects have not been considered this should be reported with an explanation of the environmental assumptions made.	• Waste or overburden material is extracted from the shallow mining activity can be backfilled to the adjacent mined out area. • Sediment pond is mandatory made to recycle the water from slurry/mud by gravitation separation method. The sediment residue itself is non poisonous material, it can be used for another purpose or left to be settled in the pond.
Bulk density	• Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples. • The bulk density for bulk material must have been measured by methods that adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit. • Discuss assumptions for bulk density estimates used in the evaluation process of the different materials.	• Based on mining block test data in 2009, the insitu wet bulk density is assumed at average 1.8 ton/m3, this value has been applied for whole deposit in Tayan Site.
Classification	• The basis for the classification of the Mineral Resources into varying confidence categories. • Whether appropriate account has been taken of all relevant factors (ie relative confidence in tonnage/grade estimations, reliability of input data, confidence in continuity of geology and metal values, quality, quantity and distribution of the data).	• The main consideration for classification of the Mineral Resources into varying confidence categories is test-pit spacing, ore continuity, and geostatistical study. • The criteria for resource classification are: - Measured resources: estimated using first search ellipse and estimated by minimum of 4 samples. - Indicated resources: estimated using first search ellipse with less than 4 samples or second search ellipse with minimum 3 samples. - Inferred resources: estimated using second search ellipse with less than 3 samples or third

Criteria	JORC Code explanation	Commentary
		search ellipse. • The result appropriately reflects the Competent Person view of the deposit.
Audits or reviews	• The results of any audits or reviews of Mineral Resource estimates.	• The results of mineral resources and ore reserves estimation had been reviewed by SNOWDEN-Australia in 2007. • No recent review from third party.
Discussion of relative accuracy/ confidence	• Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors that could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	• Bauxite resources at Antam Tayan project area is sufficient to generate a large scale economic project. • The Mineral Resource and grades are reliable due to the large number of test pits and samples. A small amount of samples still have problem with validation but it is not significant comparing to the whole exploration test pit database. • Bauxite resources estimated are considerably economic. • Referring to production data since 2014 to 2019, mine reconciliation showing a small variance of tonnage (<5%) and Al2O3 content (<1%), however the R-SiO2 content still showing fluctuates variance number around 30%.

Table 1 - JORC Code, 2012 Edition

Section 4 Estimation and Reporting of Ore Reserves of **Tayan IUP**

Criteria	JORC Code Explanation	Commentary
Mineral Resource estimate for conversion to Ore Reserves	• Description of the Mineral Resource estimate used as a basis for the conversion to an Ore Reserve. • Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Ore Reserves.	• Ore reserve estimation in Tayan mining concession has been determined as part of and classified based on measured and indicated resources into proved and probable ore reserves • The measured and indicated bauxite resources are inclusive of those mineral resources modified to produce the ore reserve
Site visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• Site visit has been conducted periodically to update and reconcile the operation progress of current mining area in Tayan, also confirming the location of the next sequence infrastructure plan. The competent person is a full time employee of PT ANTAM (Persero) Tbk, which is based at head office
Study status	• The type and level of study has undertaken to enable Mineral Resources to be converted to Ore Reserves. • The Code requires that a study to at least Pre-Feasibility Study level has been undertaken to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable and that material Modifying Factors have been considered.	• Mine Block Test study was conducted at 2009 • Geotechnical test was conducted in 2012 and updating data was undertaken at 2019, in addition data enrichment for infrastructure purposes were also acquired. • Feasibility study (FS) has been conducted for Tayan Mining Concession with assumption of data and production target as per year of 2014. As for 2018, FS has been updated to face bauxite ore export opportunity. • Analysis of Environmental Impact (AMDAL) study was conducted at 2014 and been granted by government.
Cut-off parameters	• The basis of the cut-off grade(s) or quality parameters applied.	• Cut off Grade (COG) is applied in Tayan block as content of T-Al_2O_3 ≥ 33 %, R- SiO_2 < 8.0 % to meet requirement bauxite specifications for export (T-Al_2O_3 ≥ 47 %, $TSiO_2$ < 9 %) and for supplying to Tayan CGA refinery (T-Al2O3 ≥ 47.8 % and RSiO2 < 3.8 %)
Mining factors or assumptions	• The method and assumptions used as reported in the Pre-Feasibility or Feasibility Study to convert the Mineral Resource to an Ore Reserve (i.e. either by application of appropriate factors by optimization or by preliminary or detailed design). • The choice, nature and appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc. • The assumptions made regarding geotechnical parameters (eg pit	• Open cast or contour mining method is advisably applied for shallow lateritic bauxite deposited in Tayan. • Overburden removal is applied by direct dozing and excavator-trucking. Access to the haul road, washing plant, and placement of sediment ponds is part of the mine planning aspect. • Geotechnical aspect such as slope height, berm width and pit slope for mine design were simulated by Finite Element Method (FEM). In addition, stability analysis for sediment pond and stockyard were also carried out, especially in swamped area. • Mining dilution is referred to mine block test study and mine operation historical reconciliation data every semester.

Criteria	JORC Code Explanation	Commentary
	slopes, stope sizes, etc), grade control and pre-production drilling. • The major assumptions were made and Mineral Resource model used for pit and stope optimization (if appropriate). • The mining dilution factors used. • The mining recovery factors used. • Any minimum mining widths used. • The manner in which Inferred Mineral Resources are utilised in mining studies and the sensitivity of the outcome to their inclusion. • The infrastructure requirements of the selected mining methods.	• Mining recovery and washing recovery are assuming as 90% and 95% referring to the result of the mine operation historical reconciliation data every semester. • In the Tayan shallow deposit lateritic mine, the average mining width is applied by 25 m to accommodate optimum heavy equipment movement. • Infrastructure plan has been done by focused on the some locations which are washing plant, sediment pond, and main haul road / access.
Metallurgical factors or assumptions	• The metallurgical process proposed and the appropriateness of that process to the style of mineralization. • Whether the metallurgical process is well-tested technology or novel in nature. • The nature, amount and representativeness of metallurgical test work undertaken, the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied. • Any assumptions or allowances made for deleterious elements. • The existence of any bulk sample or pilot scale test work and the degree to which such samples are considered representative of the orebody as a whole. • For minerals that are defined by a specification, has the ore reserve estimation been based on the appropriate mineralogy to meet the specifications?	• Metallurgical test has been commenced by trial washed bauxite shipping in 2012 from Tayan to Showadenko Chemical Grade Alumina (CGA) plant which was operated in Yokohama, Japan. No significant issues had been found by Showadenko regarding the test. • Ore specifications are described as follow: - For bauxite export: Al2O3 47% RSiO2 <9%. - For CGA Plant: Al2O3 47.8% and TsiO2 <3.8% The ore reserves estimation use this specifications as mine scheduling target consideration.
Environmental	• The status of studies of potential environmental impacts of the mining and processing operation. Details of waste rock characterization and the consideration of potential sites, status of design options considered and, where applicable, the status of approvals for process residue storage and waste dumps should be reported.	• Analysis of Environmental Impact (AMDAL) Report has been approved by government for both Tayan mining and CGA Plant. • Bauxite Residue (Red Mud) from CGA Plant has been studied to align with the regulation and placed in the bauxite residue placement area.
Infrastructure	• The existence of appropriate infrastructure: availability of land for	• All constructions of initial infrastructures and plant facilities has been accomplished. At the time, CGA

Criteria	JORC Code Explanation	Commentary
	plant development, power, water, transportation (particularly for bulk commodities), labour, accommodation; or the ease with which the infrastructure can be provided, or accessed.	Plant Tayan has started the commercial operation stage, since 2014. • Some other constructions for sustainable infrastructure will follow as mine area progress.
Costs	• The derivation of, or assumptions made, regarding projected capital costs in the study. • The methodology used to estimate operating costs. • Allowances made for the content of deleterious elements. • The derivation of assumptions made of metal or commodity price(s), for the principal minerals and co-products. • The source of exchange rates used in the study. • Derivation of transportation charges. • The basis for forecasting or source of treatment and refining charges, penalties for failure to meet specification, etc. • The allowances made for royalties payable, both Government and private.	• Cost assumptions were made based on financial model which referred to the Sale and Purchase Agreement (SPA) between ANTAM and Tayan CGA Plant. Those assumptions are exchange rate, ore price, mine investment and operational plan, and ore selling scenario. • Ore transportation cost from mining to CGA Plant's stockyard is charged by ANTAM. • The basis for forecasting was based on SPA between ANTAM and ICA. • Royalty and other dues are calculated and paid based on the regulation.
Revenue factors	• The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc. • the derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.	• The revenue factors and formula were derived from ANTAM – CGA Plant's SPA and Export (until 2021) as the consumer of Tayan bauxite ore. • Ore specifications are described as follow: - For bauxite export: Al2O3 47% RSiO2 <9%. - For CGA Plant: Al2O3 47.8% and TsiO2 <3.8%
Market assessment	• The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future. • A customer and competitor analysis along with the identification of likely market windows for the product. • Price and volume forecasts and the basis for these forecasts. • For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.	• Market Assessment for Alumina product is the domain of ICA. In term of ore selling price from mining to CGA Plant, the prices is based on SPA. • Market Assessment for Export product is the domain of ANTAM Marketing and Sales division.

Criteria	JORC Code Explanation	Commentary
Economic	• The inputs to the economic analysis to produce the net present value (NPV) in the study, the source and confidence of these economic inputs including estimated inflation, discount rate, etc. • NPV ranges and sensitivity to variations in the significant assumptions and inputs.	• The inputs to the economic analysis are aligned with Corporate Long Term parameters of ANTAM (rolling every five years) and Yearly Budget Plan.
Social	• The status of agreements with key stakeholders and matters leading to social licence to operate.	• Government, society and key stakeholders have been supported ANTAM and ICA to operate in Tayan Area by giving issued-permits regarding to mining and plant operation.
Other	• To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves: • Any identified material naturally occurring risks. • The status of material legal agreements and marketing arrangements. • The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect that all necessary Government approvals will be received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third party on which extraction of the reserve is contingent.	• Land acquisitions issues are significantly considered concerning of mining lifetime. In addition, the acquisitions are still on the progress, especially in the southern and western block that should be acquired for next 20-30 years mining period.
Classification	• The basis for the classification of the Ore Reserves into varying confidence categories. • Whether the result appropriately reflects the Competent Person's view of the deposit. • The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).	• The basis for the ore reserve classification are referring to the resources classification and assessment of Modifying Factors. • All measured mineral resources have been convert into Proved Ore Reserves, there is no consideration yet to put some proportion of measured mineral resources to be converted into probable ore reserve • The ore reserves result appropriately reflect the competent person's view of the deposit. • The classification of proven and probable ore reserves is based on the confidence categories of measured and indicated resources.

Criteria	JORC Code Explanation	Commentary
Audits or reviews	• The results of any audits or reviews of Ore Reserve estimates.	• Ore Reserve estimation had been reviewed by SNOWDEN in 2007-2008
Discussion of relative accuracy/ confidence	• Where appropriate a statement of the relative accuracy and confidence level in the Ore Reserve estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to **global or local estimates**, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage. • It is recognized that this may not be possible or appropriate in all circumstances. These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	• Bauxite ore reserve estimation report provides the global estimation of ore presence and ore quality distribution and its distribution are validated between data and actual test-pit condition. • Reserve validation were also additionally compared to mining reconciliation. • Data accuracy could be improved by conducting robust operation monitoring • Annual Mining Plan reviewed by comparing with ANTAM's Annual Work Plan & Budget • Commodity price, mining cost, and government's regulation give the biggest impact for reserves estimation.

Table 1 - JORC Code, 2012 Edition

Section 3 Estimation and Reporting of Mineral Resources of **Mempawah, Landak , and PT BEI IUPs**

Criteria	JORC Code explanation	Commentary
Database Integrity	• *Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mmineral Resources estimation purposes.* • *Data validation procedures used*	• The database was thoroughly tested and validated. • Resource estimation team were validated the data regarding the collar, assay, and lithology into drillhole data. If there's any error, the data will be re-evaluated by comparing database and exploration team's data. • Validating data has been conducted to avoid zone interspace and duplicate collar exploration test pit data and it has been verified by resource estimation team by comparing between geologist assessment and assay result. • The data validation such as validate the collar, Lidar topography, sample interval, sample logging description, and assay. • Clarify and analyze between the total assay and raw data include laboratorium check. In addition, re-check supposed to be applied if necessary.
Site visits	• *Comment on any site visits undertaken by the Competent Person and the outcone of those visits.* • *If no site visits have benn undertaken indicate why this is the case.*	• Site visit has been done several times by competent person to capture the actual condition of the site, discussed with exploration team, and advisably proposed some improvement.
Geological Interpretation	• *Confidence in (or conversely, the uncertainty of) the geological interpretation of the mineral deposit.* • *Nature of the data used and of any assumptions made.* • *The effect, if any, of alternative interpretations on Mineral Resources estimation.* • *The use of geology in guiding and controlling Mineral Resource estimation.* • *The factors affecting continuity both of grade and geology.*	• Sample checking were shown a good correlation. • Data acquisition in a whole prospected area were shown in a good continuity of bauxite thickness, the grade distribution was shown good homogeneity in the same mineralization domain. • The geological domain of mineralization is modeled from the surface mapping and petrography-mineralogy sample. The initial domain from exploration geologist then confirmed to geochemical distribution and test pit logging data in Exploratory Data Analysis. There are 3 domains defined to be separately estimated in resource modeling: - Domain 1: intermediate hosted rock bauxite (lava andesite, andesite-phorphyry, diorite) - Domain 2: felsic hosted rock bauxite (granodiorite, quartz-monzonite, granite) - Domain 3: vulcanic (tuff, conglomerate)

Criteria	JORC Code explanation	Commentary
		• Depth of test pit data is correctly reported, however some of the test pit elevation data were still incorrect elevation. The remaining error is corrected by adjusting to the latest Lidar data. • Lateritic boundary is generated using the bottom contour of each hill and it used to constraint the resource estimation area.
Dimensions	• *The extent and variability of the mineral resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.*	• The geometry, depth and distribution of bauxite ore are well constrained by close spacing test-pit and morphology topography. • The top and bottom of bauxite layer is determined by geologist in test pit logging process. The top of bauxite layer starting from changing of latosol interval (fine grain) to bauxite interval indicated by the presence of concretion. Bottom of bauxite is determined by the presence of clay material (kong). • The thickness bauxite layer is about 3.3 meters in average, and overburden layer is about 1.96 meters in average, for Mempawah bauxite deposit. • The thickness bauxite layer is about 4 meters in average, and overburden layer is about 3.5 meters in average, for Landak bauxite deposit. • The thickness bauxite layer is about 3.97 meters in average, and overburden layer is about 3.55 meters in average, for BEI bauxite deposit.
Estimation and modelling techniques	• *The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domaining, interpolation parameters and maximum distance of extrapolation from data points. If a computer assisted estimation method was chosen include a description of computer software and parameters used.* • *The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resources estimate takes appropriate account of such data.* • *The assumptions made regarding recovery of by-products.* • *Estimation of deleterious elements or other non-grade variables of economic significance (eg sulphur for acid mine drainage characterization).* • *In the case of block model*	• The resource modelling and estimation have been undertaken in Datamine studio RM software, statistical and geostatistical undertaken using Snowden Supervisor software. • Bauxite resources is estimated in washed bauxite, the concretion factor is the ratio between washed bauxite to crude bauxite in percent tonnage. Then it is estimated to every cell of block model to convert from crude bauxite into washed bauxite. • Washed bauxite samples were analysed with XRF methode for Al2O3, Fe2O3, T-SiO2, TiO2 and Wet analysis methode for R- SiO2 in Antam's internal laboratory. The 5 elements then estimated to resource block model to obtain the grade distribution. • Grade distribution in resource model was estimated by kriging method in bauxite zone using raw data from test pit as input data. • Outlier data were top cut after statistically approaches have been applied. This approach was conducted to avoid overestimate calculation due to the outlier data. • Variography was analysed in top flatten of ore elevation.

Criteria	JORC Code explanation	Commentary
	interpolation, the block size in relation to the average sample spacing and the search employed. • *Any assumptions behind modelling of selective mining units.* • *Any assumptions about correlation between variables.* • *Description of how the geological interpretation was used to control the resource estimates.* • *Discussion of basis for using or not using grade cutting or capping.* • *The process of validation, the checking process used, the comparison of model data to drillhole data, and use of reconciliation data if available.*	• Search distance in grade estimation was used the range of variography. The searching volume is ellipse, three searching volume was applied to interpolate the grades. First search ellipse as a main searching volume is 75 m × 75 m × 10 m. The second search ellipse is twice of first search ellipse and the third search ellipse is four times of first search ellipse. • Minimum and maximum sample number for the first search ellipse are 2 and 4 respectively, for the second search ellipse are 3 and 8 respectively, and for the third search ellipse are 4 and 12 respectively. • Block model for resource estimation was calculated in 12.5 x 12.5 x 2 m of parent block size for the area with test pit spacing 25 x 25 meter and 50 x 50 m. While for area with test pit spacing equal and above 100 x 100 m was using 25 x 25 x 2 m parent block size. Although the parent block size is different according to test pit spacing, but the individual cell/subcell size is 12.5 x 12.5 x 2 m to maintain the accuracy of the volume following the layer wireframes. • The grade was estimated into block model in top flatten of ore elevation and returned to actual/true elevation after grade estimation. • Controlling boundary of resource estimation as geological domaining, boundary laterite, and top–bottom bauxite layer from testpit sample interval. • Compare and analyze the statistic resume such as mean, min, max, etc. • Block model validation by creating section to display grade in estimated block model and test pit, then comparing the appropriateness of grade distribution visually between actual and estimated grade. • Swath plot was used to validate the grade in block model compared to actual sample graphically. • Results of the estimation is always compared to previous estimation.
Moisture	• *Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.*	• Tonnages are estimated both on wet and dry basis. • The average moisture content that used in Mempawah (Toho), landak and PT BEI resource estimation is approximately 15%.

Criteria	JORC Code explanation	Commentary
Cut-off parameters	• *The basis of adopted cut-off grade(s) or quality parameters applied.*	• The basis cut-off grade (COG) and quality parameters are applied to meet the requirement for Smelter Grade Alumina Refinery (SGAR) plant bauxite feed and bauxite export specifications. The bauxite specification target are Al2O3 40-43% and maximum 4.5 % of RSiO2 for SGAR plant. • The chemical cut-offs were based mainly on total alumina% (T-Al2O3) and reactive silica% (R-SiO2) according to the mineralization domain as follows: COG for Mempawah (Toho): - Domain 1: Al2O3>=30 - Domain 2: Al2O3>=31 and RSiO2<8 - Domain 3: Al2O3>37.5 and RSiO2<8 • COG for Landak: - Domain 1: Al2O3>=36 and RSiO2<8 - Domain 2: Al2O3>=39 and RSiO2<8 - Domain 3: Al2O3>40 and RSiO2<8 • COG for BEI: - Domain 1: no cut off - Domain 2: Al2O3>=36 and RSiO2<8 - Domain 3: Al2O3>=39 and RSiO2<8
Mining factors or assumptions	• *Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential mining methods and parameters when estimating Mineral Resources may not always be rigorous. Where this is the case, this shoul be reported with an explanation of the basis of the mining assumptions made.*	• Lateritic bauxite deposits in west Kalimantan are typically shallow deposit with the depth of bauxite layer bottom approximately 6 to 12 meters from the surface. Open cast surface mining is the most suitable mining method to be applied for this type of deposit. Selective mining can be applied properly in shallow deposit to minimize mine dilution.
Metallurgical factors or assumptions	• *The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential metallurgical methods, but the assumpstions regarding metaluurgical treatment process and parameters are made when reporting Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of*	• Based on detailed chemical analysis, reactive silica and available alumina data that applied in Cut-off Grade is possible to assess the metallurgical amenability of the bauxite. Mempawah (Toho), Landak, and PT BEI bauxite commonly can be categorized as medium to low grade bauxite with medium to high silica content, it is suitable enough to be processed for smelter grade alumina by bayer process.

Criteria	JORC Code explanation	Commentary
	the basis of the metallurgical assumptions made.	
Environmental factors or assumptions	• *Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfields project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported. Where these aspects have not been considered this should be reported with an explanation of the envinronmental assumptions made.*	• Waste or overburden material is extracted from the shallow mining activity can be backfilled to the adjacent mined out area. • Sediment pond is mandatory made to recycle the water from slurry/mud by gravitation separation method. The sediment residue itself is non poisonous material, it can be used for another purpose or left to be settled in the pond.
Bulk density	• *Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurement, the nature, size and representativeness of the samples.* • *The bulk density for bulk material must have been masured by methods that adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit.* • *Discuss assumptions for bulk density estimates used in the evaluation process of the different materials.*	• Based on 2009 mining block test data in Tayan (similar deposit as reference) the insitu wet bulk density is assumed at average 1.8 ton/m3, this value has been applied for whole deposit in Mempawah (Toho), Landak and PT BEI. • It also supported by research test pit in Mempawah (Toho), Landak, and BEI that showing similar average value for density.
Classification	• *The basis for the classification of the Mineral Resources into varying confidence categories.* • *Whether appropriate account has been taken of all relevant factors (ie relative confidence in tonnage/grade estimations, reliability of input data, confidence in continuity of geology and metal values, quality, quantity and distribution of the data).*	• The main consideration for classification of the Mineral Resources into varying confidence categories is test-pit spacing, ore continuity, and geostatistical study. It expressed by the value of Krigging Efficiency (KE). • The criteria for resource classification for Mempawah (Toho), Landak, and BEI are: - Measured resources : KE >= 0.5

Criteria	JORC Code explanation	Commentary
	• *Whether the result appropriately reflects the Competent Persons's view of the deposit.*	- Indicated resources: KE >= 0.3 and < 0.5 - Inferred resources: KE < 0.3 • The result appropriately reflects the Competent Person view of the deposit.
Audits or reviews	• *The results of any audits or reviews of Mineral Resources estimates.*	• SRK Consulting Australia was hired by ANTAM to assess the bauxite resource in Mempawah-Landak-BEI in 2013. • In 2018, Chalco engaged Mining-One to review the bauxite resource estimated of Mempawah-Landak-BEI for SGAR Mempawah cooperation continuity.
Discussion of relative accuracy/ confidence	• *Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resources estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostastitical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors that could affect the relative accuracy and confidence of the estimate.* • *The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used.* • *These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.*	• Bauxite resources at Antam Mempawah (Toho), Landak, and PT BEI project area is sufficient to generate a large scale economic project. • The Mineral Resource and grades are reliable due to the large number of test pits and samples. A small amount of samples still have problem with validation but it is not significant comparing to the whole exploration test pit database. • Bauxite resources estimated are considerably economic. • Referring to production data since 2014 to 2019, mine reconciliation showing a small variance of tonnage (<5%) and Al2O3 content (<1%), however the R-SiO2 content still showing fluctuates variance number around 30%.

Table 1 - JORC Code, 2012 Edition

Section 4 Estimation and Reporting of Ore Reserves of **Mempawah, Landak , and PT BEI IUPs**

Criteria	JORC Code Explanation	Commentary
Mineral Resource estimate for conversion to Ore Reserves	• *Description of the Mineral Resource estimate used as a basis for the conversion to an Ore Reserve.* • *Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Ore Reserves.*	• Ore reserve estimation in Mempawah (Toho), Landak, and PT BEI mining concession has been determined as part of and classified based on measured and indicated resources into proved and probable ore reserves • The measured and indicated bauxite resources are inclusive of those mineral resources modified to produce the ore reserve
Site visits	• *Comment on any site visits undertaken by the Competent Person and the outcome of those visits.* • *If no site visits have been undertaken indicate why this is the case.*	• Site visit has been conducted several times to update the condition and conduct mine infrastructure plan field survey in the mining consession area in Mempawah (Toho), Landak, PT BEI, to confirm the location of the next sequence infrastructure plan. The competent person is a full time employee of PT ANTAM (Persero) Tbk, which is based at head office
Study status	• *The type and level of study has undertaken to enable Mineral Resources to be converted to Ore Reserves.* • *The Code requires that a study to at least Pre-Feasibility Study level has been undertaken to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable and that material Modifying Factors have been considered.*	• Geotechnical test was conducted in 2019 in Mempawah (Toho) to obtain geotechnical data for mining and infrastructure purposes. The geotechnical sampling and testing are also planned to conduct in Landak and BEI area in 2020. • Feasibility study (FS) has been conducted for Mempawah (Toho), Landak, and PT BEI Mining in 2019. • Analysis of Environmental Impact (AMDAL) study has been conducted and been granted by government in January 2020 for IUP Mempawah (Toho), and in 2013 & 2014 for IUP Landak and PT BEI
Cut-off parameters	• *The basis of the cut-off grade(s) or quality parameters applied.*	• COG for Mempawah (Toho): - Domain 1: Al2O3>=30 - Domain 2: Al2O3>=31 and RSiO2<8 - Domain 3: Al2O3>37.5 and RSiO2<8 • COG for Landak: - Domain 1: Al2O3>=36 and RSiO2<8 - Domain 2: Al2O3>=39 and RSiO2<8 - Domain 3: Al2O3>40 and RSiO2<8 • COG for BEI: - Domain 1: no cut off - Domain 2: Al2O3>=36 and RSiO2<8 - Domain 3: Al2O3>=39 and RSiO2<8

Criteria	JORC Code Explanation	Commentary
Mining factors or assumptions	• *The method and assumptions used as reported in the Pre-Feasibility or Feasibility Study to convert the Mineral Resource to an Ore Reserve (i.e. either by application of appropriate factors by optimization or by preliminary or detailed design).* • *The choice, nature and appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc.* • *The assumptions made regarding*	• Open cast or contour mining method is advisably applied for shallow lateritic bauxite deposited in Mempawah (Toho), Landak, PT BEI. • Overburden removal is applied by direct dozing and excavator-trucking. Access to the haul road, washing plant, and placement of sediment ponds is part of the mine planning aspect. • Geotechnical aspect such as slope height, berm width and pit slope for mine design were simulated by Finite Element Method (FEM). In addition, stability analysis for sediment pond and stockyard were also carried out, especially in swamped area. • Mining dilution is referred to mine block test study and historical mine operation in Tayan
	• *geotechnical parameters (e.g. pit slopes, stope sizes, etc), grade control and pre-production drilling.* • *The major assumptions were made and Mineral Resource model used for pit and stope optimization (if appropriate).* • *The mining dilution factors used.* • *The mining recovery factors used.* • *Any minimum mining widths used.* • *The manner in which Inferred Mineral Resources are utilised in mining studies and the sensitivity of the outcome to their inclusion.* • *The infrastructure requirements of the selected mining methods.*	• Mining recovery and washing recovery are assuming as 90% and 95% referring to the result of the mine operation historical reconciliation data every semester. • In the Mempawah (Toho), Landak, PT BEI. shallow deposit lateritic mine, the average mining width is applied by 25 m to accommodate optimum heavy equipment movement. • Infrastructure plan has not built yet.
Metallurgical factors or assumptions	• *The metallurgical process proposed and the appropriateness of that process to the style of mineralization.* • *Whether the metallurgical process is well-tested technology or novel in nature.* • *The nature, amount and representativeness of metallurgical test work undertaken, the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied.* • *Any assumptions or allowances made for deleterious elements.* • *The existence of any bulk sample or pilot scale test work and the degree to which such samples are considered representative of the orebody as a whole.* • *For minerals that are defined by a specification, has the ore reserve estimation been based on the appropriate*	• Metallurgical test has been commenced by trial by Shenyang Aluminium & Magnesium Institute which based in China. No significant issues have been found regarding the test. • Ore specifications for SGA Plant are Al2O3 >40.34% and RSiO2 <3.2% (by bomb digest analysis, or equal to 4.5% by Wet Analysis in Geomin Laboratory) • The ore reserves estimation use this specifications as mine scheduling target consideration.

Criteria	JORC Code Explanation	Commentary
	mineralogy to meet the specifications?	
Environmental	• *The status of studies of potential environmental impacts of the mining and processing operation. Details of waste rock characterization and the consideration of potential sites,*	• Analysis of Environmental Impact (AMDAL) Report has been approved by government for Mempawah (Toho), Landak, and PT BEI as well as Smelter Grade Plant (SGA). • Bauxite Residue (Red Mud) from SGA Plant has been studied to align with the regulation and placed in the bauxite residue placement area.
	• *status of design options considered and, where applicable, the status of approvals for process residue storage and waste dumps should be reported.*	
Infrastructure	• *The existence of appropriate infrastructure: availability of land for plant development, power, water, transportation (particularly for bulk commodities), labour, accommodation; or the ease with which the infrastructure can be provided, or accessed.*	• All constructions of infrastructures have just started in IUP Mempawah (Toho) by conducting Land acquisition, lan leveling for fist washing plant and constructing part of Main Haulage Road inside the IUP area. At this time, SGAR Plant will start the commercial operation stage in the end 2021 and IUP Mempawah Mine will become the first 5 years ore supplier for the refinery.
Costs	• *The derivation of, or assumptions made, regarding projected capital costs in the study.* • *The methodology used to estimate operating costs.* • *Allowances made for the content of deleterious elements.* • *The derivation of assumptions made of metal or commodity price(s), for the principal minerals and co- products.* • *The source of exchange rates used in the study.* • *Derivation of transportation charges.* • *The basis for forecasting or source of treatment and refining charges, penalties for failure to meet specification, etc.* • *The allowances made for royalties payable, both Government and private.*	• Cost assumptions were made based on mining financial model and will be synchronized with the Sale and Purchase Agreement (SPA) between ANTAM and SGA before start the operation. Those assumptions are exchange rate, mine investment and operational plan, ore price, and ore selling scenario. • Ore transportation cost from mining to SGA Plant's stockyard is charged by ANTAM. • The basis for forecasting was based on ANTAM data and BFS document of SGAR Mempawah. • Royalty and other dues are calculated and paid based on the regulation.
Revenue factors	• *The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc.* • *the derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.*	• The revenue factors and formula were derived from ANTAM – SGA Plant's SPA as the consumer of bauxite ore. • Ore specifications for SGAR Mempawah Plant are Al2O3 ≥40.34% and RSiO2 <3.2%

Criteria	JORC Code Explanation	Commentary
Market assessment	• *The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future.* • *A customer and competitor analysis along with the identification of likely market windows for the product.* • *Price and volume forecasts and the basis for these forecasts.* • *For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.*	• Market Assessment for Alumina product is the domain of PT Borneo Alumina Indonesia as the owner of SGAR Plany. In term of ore selling price from mining to SGA Plant, the prices is based on SPA. • Market Assessment for SGA Plant is the domain of ANTAM Marketing and Sales division.
Economic	• *The inputs to the economic analysis to produce the net present value (NPV) in the study, the source and confidence of these economic inputs including estimated inflation, discount rate, etc.* • *NPV ranges and sensitivity to variations in the significant assumptions and inputs.*	• The inputs to the economic analysis are aligned with Corporate Long Term parameters of ANTAM (rolling every five years) and Yearly Budget Plan.
Social	• *The status of agreements with key stakeholders and matters leading to social licence to operate.*	• Government, society and key stakeholders have been supported ANTAM and SGA to operate in Mempawah (Toho), Landak, and PT BEI by giving issued-permits regarding to mining and plant operation.
Other	• *To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves:* • *Any identified material naturally occurring risks.* • *The status of material legal agreements and marketing arrangements.* • *The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect that all necessary Government approvals will be received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third party on which extraction of the reserve is contingent.*	• Land acquisitions issues are significantly considered concerning of mining lifetime. In addition, the acquisitions are still on the progress, starting from IUP Mempawah (Toho) area.
Classification	• *The basis for the classification of the Ore Reserves into varying confidence categories.* • *Whether the result appropriately reflects*	• The basis for the ore reserve classification are referring to the resources classification and assessment of Modifying Factors. • All measured mineral resources have been

Criteria	JORC Code Explanation	Commentary
	the Competent Person's view of the deposit. • *The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).*	converted into Proved Ore Reserves, there is no consideration yet to put some proportion of measured mineral resources to be converted into probable ore reserve • The ore reserves result appropriately reflect the competent person's view of the deposit. • The classification of proven and probable ore reserves is based on the confidence categories of measured and indicated resources.
Audits or reviews	• *The results of any audits or reviews of Ore Reserve estimates.*	• The ore reserves estimation of Mempawah, Landak, and BEI IUPs are not already reviewed or audited by other party because it has just released in the end of 2019
Discussion of relative accuracy/ confidence	• *Where appropriate a statement of the relative accuracy and confidence level in the Ore Reserve estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate.* • *The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used.* • *Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage.* • *It is recognized that this may not be possible or appropriate in all circumstances. These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.*	• Bauxite ore estimation report provides the global estimation of ore presence and ore quality distribution and its distribution are validated between data and actual test-pit condition. • Reserve validation were also additionally compared to mining reconciliation. • Data accuracy could be improved by conducting robust operation monitoring • Annual Mining Plan reviewed by comparing with ANTAM's Annual Work Plan & Budget • Commodity price, mining cost, and government's regulation give the biggest impact for reserves estimation.

Table 1 - JORC Code, 2012 Edition

Section 3 Estimation and Reporting of Mineral Resources of **Pongkor Prospect**

Criteria	JORC Code explanation	Pongkor
Database integrity	• Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes. • Data validation procedures used.	• Data Verification using visual, database cross checks and statistics were used to find errors in the database. • Only Drill holes with reliable data were reported in the Resources. • Improvement in Data storage and data entry procedures and recovery of some past data has been done to make the data verificated • The Data that used in resource estimation process is the same data from database division which has been done to standardize it sources whether from lab or exploration team. • Data created as a series of Microsoft Office Excel softwares files. Separate file is created for each: collar, survey, assay and geology (lithology table). • Data validation using CAE Datamine Studio 3 software consisted for checking for sample interval, geological logging overlaps, and for duplicate collars. • Validated the data with building the collar, assay, and lithology data into drill hole data. If there's any error, the data will check from raw data • Zero result, negative result or NA result data changed become half of detection limit and unidentified assay become absent data.
Site visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• A site visit was undertaken and reported under by PT Stania Bara Consulting. • Competent Person Team visited the gold site. • Field exposures were examined during this visit, and an assessment was made of the procedures for logging, sample preparation, quality control and field mapping practice.

Criteria	JORC Code explanation	Pongkor
Geological interpretation	• Confidence in (or conversely, the uncertainty of) the geological interpretation of the mineral deposit. • Nature of the data used and of any assumptions made. • The effect, if any, of alternative interpretations on Mineral Resource estimation. • The use of geology in guiding and controlling Mineral Resource estimation. • The factors affecting continuity both of grade and geology.	• All recent economic gold-silver mineralization estimated at Pongkor Gold Mine is the series of steeply dipping low sulphidation epithermal veins system. Geological interpretation work has been done based on vein and host rock lithology from core drilling developed specifically for low sulphidation epithermal mineralization in Pongkor Gold Mine. • Geological interpretation was created in order to construct a geological model on which was used for resource estimation. The vein correlation has been used to control volume and estimations that predominantly based on geological attributes and observations from drill core, particularly epithermal vein textures rather than grade criteria. In most cases, a clear distinction between main epithermal quartz vein structures and surrounding stockwork Mineralization or barren host rock can be determined based on detailed geological logging, core photography and assay.
Dimensions	• The extent and variability of the Mineral Resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.	• The veins in Pongkor Gold Mine have varying width between 1 m to 10 m with 500 to 1,000 m length and 450 m mean sea level.
Estimation and modelling techniques	• The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domaining, interpolation parameters and maximum distance of extrapolation from data points. If a computer assisted estimation method was chosen include a description of	• The Pongkor Gold Mine Resource Estimation contains estimates for gold and silver only. Gold is the primary economic metal with silver a by-product metal. • Resource estimate applied a three dimensional (3D) method approach for ore body construction. This estimation method used a composite data throughout the vein penetration.

Criteria	JORC Code explanation	Pongkor
	computer software and parameters used. • The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data. • The assumptions made regarding recovery of by-products. • Estimation of deleterious elements or other non-grade variables of economic significance (eg sulphur for acid mine drainage characterisation). • In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed. • Any assumptions behind modelling of selective mining units. • Any assumptions about correlation between variables. • Description of how the geological interpretation was used to control the resource estimates. • Discussion of basis for using or not using grade cutting or capping. • The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available.	The grade estimation applied inverse distance weighting to the power of 2 (IDS) method with CAE Datamine Studio 3 software. Top cut has been applied to the estimation. Both grade control and resource estimation models use the same methodology. Estimates are routinely validated against production data where available. • The geology domain based on the lithology (vein)., it used to control volume and estimations. • The size of block is vein width x 2.5 m (tunnel blast) x 4 m (tunnel height). • Maximum distance of extrapolation is 150 m x 150 m x 70 m. • Estimates result compared with previous estimates, and being synchronized with mining production data.
Moisture	• Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.	• Tonnages are estimated both on wet and dry basis. • Moisture was based on previous data to be 15%.
Cut-off parameters	• The basis of the adopted cut-off grade(s) or quality parameters applied.	• Cut of grade is derived from the economic parameters (price and cost). Price is assumed at $1458/oz. Other cost parameters

Criteria	JORC Code explanation	Pongkor
		refer to actual cash cost from historical data. The cut-off grade the applied in mineral resource estimate are 3 g/t Au.
Mining factors or assumptions	• Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential mining methods, but the assumptions made regarding mining methods and parameters when estimating Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the mining assumptions made.	• The Mineral Resource Estimate is reported constrained within an Underground Mine Design because land use area (protected forest and national park). • Crown pillar between surface and the higher roof is 25 meters due to underground mining method and geotechnical condition to support the tunnel. • Lower elevation is 450 to 475 meters elevation due to low grade and groundwater condition. • The boundary generally limited wih cut-off grades.
Metallurgical factors or assumptions	• The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential metallurgical methods, but the assumptions regarding metallurgical treatment processes and parameters made when reporting Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the metallurgical assumptions made.	• Pongkor has a conventional carbon in leach plant for recovery of gold and silver. The ore mineralogy of Mineral Resources in Pongkor meet with the metallurgical requirements of this plant. • Based on the detailed chemical analyses, ore grade that applied above Cut-off Grade is possible to assess the metallurgical process.

Criteria	JORC Code explanation	Pongkor
Environmental factors or assumptions	• Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfields project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported. Where these aspects have not been considered this should be reported with an explanation of the environmental assumptions made.	• The location of mineral resources is in protected forest which has land use permit. • The using of crown pillar between surface and the tunnel roof to keep the surface safe from subsidence.
Bulk density	• Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples. • The bulk density for bulk material must have been measured by methods that adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit. • Discuss assumptions for bulk density estimates used in the evaluation process of the different materials.	• Bulk density was measured in many production tunnel front with chip channel sampling method. The in situ bulk density estimated at 2.50 ton/m^3 and this value has been used across all the mineral deposit.
Classification	• The basis for the classification of the Mineral Resources into varying confidence categories. • Whether appropriate account has been taken of all relevant factors (ie relative confidence in tonnage/grade estimations, reliability of input data,	• The main basis for the classification of the Mineral Resources into varying confidence categories is the drill holes spacing, ore continuity, and production chip channel sampling.

Criteria	JORC Code explanation	Pongkor
	confidence in continuity of geology and metal values, quality, quantity and distribution of the data). • Whether the result appropriately reflects the Competent Person's view of the deposit.	• Inferred Resources are typically described greater than 70 m spacing, Indicated Resources from 30 – 70 spacing and Measured Resources lower than 30 m spacing. • The result appropriately reflects the Competent Persons view of the deposit.
Audits or reviews	• The results of any audits or reviews of Mineral Resource estimates.	• The most recent independent review was conducted by PT Stania Bara Consulting for under 2010 Mineral Resource. This review did not identify any material issues with the data inputs, resource estimate and process used in the estimate and concluded that the estimate had been prepared using good industry practice and has been appropriately classified.
Discussion of relative accuracy/ confidence	• Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors that could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • These statements of relative accuracy and confidence of the estimate should	• The accuracy and confidence level of the mineral resources estimation is proved by comparing the estimated quality (tonnage, vein width, grades) of the mineral resources which is converted to ore reserves with actual production in the same position (coordinates and elevation), the comparison results are expressed by percent (%). • The comparison percentage statement between the estimation and the actual production is taken from global estimates which is resulted from average of local estimates of each actual production location. • Detailed monthly mine and mill reconciliations have been maintained since production commenced.

Criteria	JORC Code explanation	Pongkor
	be compared with production data, where available.	

Table 1 - JORC Code, 2012 Edition

Section 4 Estimation and Reporting of Ore Reserves of **Pongkor Prospect**

Criteria	JORC Explanation	Comment
Mineral Resources estimate for conversion to Ore Reserves	• Description of the Mineral Resources estimate used as a basis for the conversion to an Ore Reserves • Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of the Ore Reserves	• Mineral resources model are estimated by Geomin (ANTAM's exploration unit) • Ore Reserves estimate has been determined as part of and classified based on measured and indicated resources into proved and probable ore reserves • The measured and indicated gold resources are inclusive of those mineral resources modified to produce the ore reserves.
Site Visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• Site visit done by Competent Person Team
Study Status	• The type and level of study undertaken to enable Mineral Resources to be converted to Ore Reserves. • The code requires that a study to at least Pre-Feasability Study level has been undertake to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable, and that material Modifying Factor have been considered.	• Feasibility Study
Cut-off parameters	• The basis of the adopted cut-off grade(s) or quality parameters applied.	• Cut of grade is derived from the economic parameters (price and cost). Price is assumed at $1458/oz. Other cost parameters refer to actual cash cost from historical data. COG for Pongkor is 4 g/t
Mining factors or assumptions	• The method and assumptions used as reported in the Pre-Feasability Study or Feasability Study to convert the Mineral Resources to an Ore Reserves (i.e. either by application of appropiate factors by optimisation or by preliminary or detailed design). • The choice, nature and appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access. Etc. • The assumptions made regarding geotechnical parameters (eg pit slopes, stope sizes, etc) grade control and pre-production drilling	• Pongkor mine applies cut and fill as mining method. The mine was optimised using MSO software. It was design using surpac software and schduled using minesched. • The primary underground access type is decline for main haulage and shaft for ventilation. • The mine is mostly composed of Rock Type of 2 and 3. • Mining Dilution at 5% • Mining Reovery at 100%

Criteria	JORC Explanation	Comment
	• The assumption made and Mineral Resources model used for pit and stope optimisation (if appropriate) • The Mining Dilution Factor Used • The Mining Recovery Factors Used • Any minimum mining widths used • The manner in which inferred Mineral Resources are utilisde in mining studies and the sensitivity of the outcome to their inclusion • The infrastructure requirements of the selected mining methods	• The Production Profile is 5x5 (Height xWidth) • The inferred mineral is not stated as reserve. However, if it is inclusive in the mine plan. It will be treated as waste material • 2019 statement : - Ore tonnage of 747 KWMT @ 4.9 g/t Au to produce 81 Koz • Current statement (2020) : - Ore tonnage of 379 KWMT @4.73 g/t to produce 39 Koz • The decrease of reserve is caused by 2019 production which is up to 376 WMT of ore tonnage and 48.2 Koz of gold. • The slight variance between previous and 2020 statement is due to the update of geological block model.
Metallurgical factors or assumptions	• The metallurgical process proposed and the appropriateness of that process to the style of mineralisation • Whether the metallurgical process is well-tested technology or novel in nature • The nature, amount and representativeness of metallurgical test work undertaken the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied. • Any assumption or allowance made for deleterious elements • The existence of any bulk sample or pilotscale test work and the degree to which such samples are considered representative of the orebody as a whole • For minerals that are defined by a spesification, has the ore reserve estimation been based on the appropriate mineralogy to meet the spesifications	• Processing Plant Recovery 90%
Environmental	• The status of studies of potential envinromental impacts of the mining and processing operation. Details of waste rock characterisation and the consideration of potential sites, status of design options considered and where applicable, the status of approvals for process residue storage and waste dumps should be reported	• AMDAL has been approved by government
Infrastructure	• The existence of appropriate infrastructure: availibility of land for plant development power,	• Done

Criteria	JORC Explanation	Comment
	water, transportation (particulary for bulk commodities), labour, accommodation; or the ease with which the infrastructure can be provided or accessed	
Costs	• The derivation of or assumptions made, regarding projected capital costs in the study • The methodology used to estimate operating costs • Allowances made for the content of deleterious elements • The source of exchange rates used in the study • Derivation of transportaion charges • The basis for forecasting or source of treatment and refining charges, penalties for failure to meet spesification, etc. • The allowances made for royalties payable, both Government and private	• Assumed from existing production data • Operating cost estimate by estimate production data • Assumed from existing production data • Exchange rates obtained assumption made in Antam's annual work plan and budget • Assumed from existing production data • Assumed from existing production data • The allowance of royalty has been considered
Revenue Factors	• The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc. • The derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.	• Metal price assumptions based on Antam's Forecast and Historical • Metal Price based LME Price cash seller ore price calculated with formula
Market assessment	• The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future. • A customer and competitor analysis along with the identification of likely market windows for the product. • Price and volume forecasts and the basis for these forecasts. • For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.	• Done • Done • Assumption made in Antam's work plan & budget • Have been considered
Economic	• The inputs to the economic analysis to produce the net present value (NPV) in the study, the source and confidence of these economic inputs including estimated inflation, discount rate, etc. • NPV ranges and sensitivity to variations in the significant assumptions and inputs.	• Input parameter : ore price, selling cost, processing cost, mining cost, mining dilution, mining recovery, annual discounting, and annual production rate • Done by various scenario
Social	• The status of agreements with key stakeholders and matters leading to social licence to operate.	• Done
Other	• To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves:	• Done • Cash cost is the important factor because of scattered ore location

Criteria	JORC Explanation	Comment
	• Any identified material naturally occurring risks. • The status of material legal agreements and marketing arrangements. • The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect that all necessary Government approvals will be received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third party on which extraction of the reserve is contingent.	• n/a • Done • No issues regarding to the mineral tenement status & government and statuory approvals.
Classification	• The basis for the classification of the Ore Reserves into varying confidence categories. • Whether the result appropriately reflects the Competent Person's view of the deposit. • The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).	• The classification of proven and probable ore reserve is based on the confidence categories of measured and indicated resources. Mining assumption is in line with these confidence levels. • n/a
Audits or reviews	• The results of any audits or reviews of Ore Reserve estimates.	• N/A
Discussion of relative accuracy/ confidence	• Where appropriate a statement of the relative accuracy and confidence level in the Ore Reserve estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage. • It is recognised that this may not be possible or appropriate in all circumstances. These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	• Acuracy could be improved by conducting robust operation monitoring • Annual mining plan is reviewed by comparing with ANTAM's annual work plan & budget • Commodity price, mining cost, and government's regulation give the biggest the impact for reserve estimation. • Mining reconciliation have been concluded to compare mine plan vs actual production

Table 1 - JORC Code, 2012 Edition

Section 3 Estimation and Reporting of Mineral Resources of **Papandayan Prospect**

Criteria	JORC Code explanation	Arinem
Database integrity	• Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes. • Data validation procedures used.	• Data Verification using visual, database cross checks and statistics were used to find errors in the database. • Only Drillholes with reliable data were reported in the Resources. • Improvment in Data storage and data entry procedures and recovery of some past data has been done to make the data verificated • The Data that used in resource estimation process is the same data from database division which has been done to standardized it sources whether from lab or exploration team. • Data created as a series of Microsoft Office Excel softwares files. Separate file is created for each: collar, survey, assay and geology (lithology table). • Data validation using CAE Datamine Studio 3 software consisted for checking for sample interval, geological logging overlaps, and for duplicate collars. • Validated the data with building the collar, assay, and lithology data into drillhole data. If there's any error, the data will check from raw data • Zero result, negative result or NA result data changed become half of detection limit and unidentified assay become absent data.
Site visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• A site visit was undertaken and reported under by LAPI ITB. • Site visit and its improvement statement were reported by competent person
Geological interpretation	• Confidence in (or conversely, the uncertainty of) the geological interpretation of the mineral deposit. • Nature of the data used and of any assumptions made. • The effect, if any, of alternative interpretations on Mineral Resource estimation. • The use of geology in guiding and controlling Mineral Resource estimation. • The factors affecting continuity both of grade and geology.	• Geological interpretation work has been done based on vein and host rock lithology from core drilling developed variation of assay data was good enough. • Geological interpretation was created in order to construct a geological model on which was used for resource estimation. The vein correlation has been used to control volume and estimations that predominantly based on geological attributes and observations from drill core, particularly epithermal vein textures rather than grade criteria. In most cases, a clear distinction between main epithermal quartz vein structures and

Criteria	JORC Code explanation	Arinem
		surrounding stockwork Mineralization or barren host rock can be determined based on detailed geological logging, core photography and assay.
Dimensions	• The extent and variability of the Mineral Resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.	• The veins in Arinem has varying width between 4m to 10m with 2.5 km length with elevation between 660 rL to 25 rL.
Estimation and modelling techniques	• The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domaining, interpolation parameters and maximum distance of extrapolation from data points. If a computer assisted estimation method was chosen include a description of computer software and parameters used. • The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data. • The assumptions made regarding recovery of by-products. • Estimation of deleterious elements or other non-grade variables of economic significance (eg sulphur for acid mine drainage characterisation). • In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed. • Any assumptions behind modelling of selective mining units. • Any assumptions about correlation between variables. • Description of how the geological interpretation was used to control the resource estimates. • Discussion of basis for using or not using grade cutting or capping. • The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available.	• Arinem Resource Estimation contains estimates for gold and silver only. Gold is the primary economic metal with silver a by-product metal. • Resource estimate applied a three dimensional (3D) method approach for ore body construction. This estimation method used a composite data throughout the vein penetration. The grade estimation applied Ordinary Kriging (OK) method with CAE Datamine Studio 3 software. Top cut has been applied to the estimation. Both grade control and resource estimation models use the same methodology. Estimates are routinely validated against production data where available. • The geology domain based on the lithology (vein), it used to control volume and estimations. • The size of block is 5m (vein width) x 15 m (vein length) x 5 m (vein thickness). • Maximum distance of extrapolation is 25 m x 115 m x 5 m. • Estimate block model grade result compared with drill hole grade result.
Moisture	• Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.	• Tonnages are estimated on wet basis. • Moisture data is 10%.

Criteria	JORC Code explanation	Arinem
Cut-off parameters	• The basis of the adopted cut-off grade(s) or quality parameters applied.	• The resource model is constrained by assumptions about economic cut-off grades. • The ore zone interpretations are based upon a low grade cut-off grade of effectively 1 gr/ton Au.
Mining factors or assumptions	• Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential mining methods, but the assumptions made regarding mining methods and parameters when estimating Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the mining assumptions made.	• The Mineral Resource Estimate is reported based on continuity of ore in drilling data. • Crown pillar between surface and the higher roof is 25 meters due to underground mining method and geotechnical condition to support the tunnel. • Lower elevation is 25 meters elevation due to low grade. • The boundary generally limited wih cut-off grades.
Metallurgical factors or assumptions	• The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential metallurgical methods, but the assumptions regarding metallurgical treatment processes and parameters made when reporting Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the metallurgical assumptions made.	• Arinem will be extracted by carbon in leach plant for gold and silver. The ore mineralogy of Mineral Resources in Arinem meet with the metallurgical requirements of this plant. • Based on the detailed chemical analyses, ore grade that applied above Cut-off Grade is possible to assess the metallurgical process.
Environmental factors or assumptions	• Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfields project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported. Where these aspects have not been considered this should be reported with an explanation of the environmental assumptions made.	• The location of mineral resources is in protected forest which has land use permit. • The using of crown pillar between surface and the tunnel roof to keep the surface safe from subsidence.

Criteria	JORC Code explanation	Arinem
Bulk density	• Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples. • The bulk density for bulk material must have been measured by methods that adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit. • Discuss assumptions for bulk density estimates used in the evaluation process of the different materials.	• Bulk density was measured in core and grab sampling method. The in situ bulk density estimated at 2.50 ton/m3 and this value has been used across all the mineral deposit.
Classification	• The basis for the classification of the Mineral Resources into varying confidence categories. • Whether appropriate account has been taken of all relevant factors (ie relative confidence in tonnage/grade estimations, reliability of input data, confidence in continuity of geology and metal values, quality, quantity and distribution of the data). • Whether the result appropriately reflects the Competent Person's view of the deposit.	• The main basis for the classification of the Mineral Resources into varying confidence categories is the drill holes spacing, and ore continuity. • Inferred Resources are typically described greater than 2 times Au grade variogram, Indicated Resources from 1-2 times Au grade variogram and Measured Resources lower than 1 time sAu grade variogram. • The result appropriately reflects the Competent Persons view of the deposit.Drill spacing of 50x50 metre until 100x100 metre (depending on deposit and variography results).
Audits or reviews	• The results of any audits or reviews of Mineral Resource estimates.	• The most recent independent review was conducted by LAPI ITB for 2018 Mineral Resource. This review did not identify any material issues with the data inputs, resource estimate and process used in the estimate and concluded that the estimate had been prepared using good industry practice and has been appropriately classified.
Discussion of relative accuracy/ confidence	• Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of	• The accuracy and confidence level of the mineral resources estimation is proved by comparing the estimated quality (tonnage, vein width, grades) of the mineral resources which is converted to ore reserves and compared to grade from drill holes.

Criteria	JORC Code explanation	Arinem
	the factors that could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	

Table 1 - JORC Code, 2012 Edition

Section 4 Estimation and Reporting of Ore Reserves of **Papandayan Prospect**

Criteria	JORC Explanation	Arinem
Mineral Resources estimate for conversion to Ore Reserves	• Description of the Mineral Resources estimate used as a basis for the conversion to an Ore Reserves • Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of the Ore Reserves	• Mineral resources model are estimated by Geomin (ANTAM's exploration unit) • Ore Reserves estimate has been determined as part of and classified based on measured and indicated resources into proved and probable ore reserves • The measured and indicated gold resources are inclusive of those mineral resources modified to produce the ore reserves.
Site Visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• Site visit done by Competent Person Team
Study Status	• The type and level of study undertaken to enable Mineral Resources to be converted to Ore Reserves. • The code requires that a study to at least Pre-Feasability Study level has been undertake to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable, and that material Modifying Factor have been considered.	• Feasibility Study
Cut-off parameters	• The basis of the adopted cut-off grade(s) or quality parameters applied.	• Cut of grade is derived from the economic parameters (price and cost). Price is assumed at $1360/oz. Other cost parameters refer to actual cash cost from historical data. COG for Arinem is Au>1 g/t
Mining factors or assumptions	• The method and assumptions used as reported in the Pre-Feasability Study or Feasability Study to convert the Mineral Resources to an Ore Reserves (i.e. either by application of appropiate factors by optimisation or by preliminary or detailed design). • The choice, nature and appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access. Etc. • The assumptions made regarding geotechnical parameters (eg pit slopes, stope sizes, etc) grade control and pre-production drilling	• Arinem Project is planned to apply underground longhole stoping. • Mining recovery is 100% • Rock Density is 2.5 ton/m^3 • Stope Size Dimension is 25 x 10 x 5m (Height, Width, Length) • Mining Dilution 5% • The Sill Drive Profile is 5x5 (Height xWidth) • The inferred mineral is not stated as reserve. However, if it is inclusive in the mine

Criteria	JORC Explanation	Arinem
	• The assumption made and Mineral Resources model used for pit and stope optimisation (if appropriate) • The Mining Dilution Factor Used • The Mining Recovery Factors Used • Any minimum mining widths used • The manner in which inferred Mineral Resources are utilisde in mining studies and the sensitivity of the outcome to their inclusion • The infrastructure requirements of the selected mining methods	plan. It will be treated as waste material • 2019 statement : - 2.708 KWMT @ 2,3 g/t Au and 183 K oz • Current statement (2020) : - 3.160.791 Wmt @2,42 g/t and 199 K oz • There was no mining production in 2019. The difference between previous and this year statement is due to the update of geological block model
Metallurgical factors or assumptions	• The metallurgical process proposed and the appropriateness of that process to the style of mineralisation • Whether the metallurgical process is well-tested technology or novel in nature • The nature, amount and representativeness of metallurgical test work undertaken the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied. • Any assumption or allowance made for deleterious elements • The existence of any bulk sample or pilotscale test work and the degree to which such samples are considered representative of the orebody as a whole • For minerals that are defined by a spesification, has the ore reserve estimation been based on the appropriate mineralogy to meet the spesifications	• Processing Plant Recovery 90%
Environmental	• The status of studies of potential envinromental impacts of the mining and processing operation. Details of waste rock characterisation and the consideration of potential sites, status of design options considered and where applicable, the status of approvals for process residue storage and waste dumps should be reported	• AMDAL has been approved by government
Infrastructure	• The existence of appropriate infrastructure: availibility of land for plant development power, water, transportation (particulary for bulk commodities), labour, accommodation; or the ease with which the infrastructure can be provided or accessed	• Done
Costs	• The derivation of or assumptions made, regarding projected capital costs in the study • The methodology used to estimate operating costs • Allowances made for the content of deleterious elements	• Assumed from project budget based on engineering design and some costs were derived based on other project cost structure with similar mining method.

Criteria	JORC Explanation	Arinem
	• The source of exchange rates used in the study • Derivation of transportaion charges • The basis for forecasting or source of treatment and refining charges, penalties for failure to meet spesification, etc. • The allowances made for royalties payable, both Government and private	• Operating cost was assumed project budget based on engineering design • Assumed from project budget based on engineering design and some costs were derived based on other project cost structure with similar mining method. • Exchange rates obtained assumption made in Antam's annual work plan and budget • Assumed from project budget based on engineering design and some costs were derived based on other project cost structure with similar mining method. • Assumed from project budget based on engineering design and some costs were derived based on other project cost structure with similar mining method. • The allowance of royalty has been considered
Revenue Factors	• The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc. • The derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.	• Metal price assumptions based on ANTAM's Forecast and Historical Data • Metal price based on LME Price Cash Seller Ore Price calculated with formula
Market assessment	• The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future. • A customer and competitor analysis along with the identification of likely market windows for the product. • Price and volume forecasts and the basis for these forecasts. • For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.	• Done • Done • Assumption made in ANTAM's work plan & budget • Have been considered
Economic	• The inputs to the economic analysis to produce the net present value (NPV) in the study, the source and confidence of these economic inputs including estimated inflation, discount rate, etc. • NPV ranges and sensitivity to variations in the significant assumptions and inputs.	• Input Parameter: Ore Price, Selling Cost, Mining Cost, Mining Dilution, Mining Recovery, Annual Discounting and Annual Production Rate • Done by various scenario

Criteria	JORC Explanation	Arinem
Social	• The status of agreements with key stakeholders and matters leading to social licence to operate.	• Done
Other	• To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves: • Any identified material naturally occurring risks. • The status of material legal agreements and marketing arrangements. • The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect that all necessary Government approvals will be received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third party on which extraction of the reserve is contingent.	• Cash cost is the important factor because of scaterred ore location • N/A • Done • No issues regarding to the mineral tenement status & government and statutory approvals
Classification	• The basis for the classification of the Ore Reserves into varying confidence categories. • Whether the result appropriately reflects the Competent Person's view of the deposit. • The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).	• The classification of proven and probable ore reserves is based on the confidence categories of measured and indicated resources. Mining assumption is in line with these levels confidence • N/A
Audits or reviews	• The results of any audits or reviews of Ore Reserve estimates.	• N/A
Discussion of relative accuracy/ confidence	• Where appropriate a statement of the relative accuracy and confidence level in the Ore Reserve estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage. • It is recognised that this may not be possible or appropriate in all circumstances. These	• Accuracy could be improved by conducting robust operation monitoring • Annual Mining Plan reviewed by comparing with ANTAM's Annual Work Plan & Budget • Commodity Price, mining cost, and governements, regulation give the biggest impact for reserves estimation

Criteria	JORC Explanation	Arinem
	statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	

Table 1 - JORC Code, 2012 Edition

Section 3 Estimation and Reporting of Mineral Resources of **Cibaliung Prospect**

Criteria	JORC Code explanation	Cibaliung
Database integrity	• Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes. • Data validation procedures used.	• Primary data was taken by geologist using logging sheet and then transferred into excel spreadsheet. For this estimation purpose, all drillhole data was compiled into SQL database "LUSSY" and backup routine by database administrator into site server and HO server to prevent data loss. Face channel sampling database are stored in Microsoft Access. • Data validation using CAE Datamine Studio 3 software consisted for checking for sample interval, geological logging overlaps, and for duplicate collars. Validated the data with building the collar, assay, and lithology data into drillhole data. If there's any error, the data will check from raw data. Zero result, negative result or NA result data changed become half of detection limit and unidentified assay become absent data. Only Drillholes with reliable data were reported in the Resources. • Spatial validation also has been done by comparing collar position actual and planned coordinate and with topo surface. 3D downhole survey anomaly check. And identyfy any inconsistance of drillholes
Site visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• Competent Person Team visited the gold site. Field exposures were examined during this visit, and an assessment was made of the procedures for logging, sample preparation, quality control and field mapping practice. • A site visit was completed
Geological interpretation	• Confidence in (or conversely, the uncertainty of) the geological interpretation of the mineral deposit.	• Systematic surface trenching, resource drilling and face mapping provide a degree of confidence in both geological

Criteria	JORC Code explanation	Cibaliung
	• Nature of the data used and of any assumptions made. • The effect, if any, of alternative interpretations on Mineral Resource estimation. • The use of geology in guiding and controlling Mineral Resource estimation. • The factors affecting continuity both of grade and geology.	model and mineralization continuity within the gross mineralized zone. However there is a degree of uncertainty in degree of grade continuation caused by complex gold distribution and high nugget effect. • Geological domain inside the mineralize zone are classify based on gold grade, high grade zone tended distribute along the hanging wall and low grade at foot wall of the vein body. • Extensive use of exploration database and systematic trenching was used too develop a shallow geological framework for the intrepetation of geological domain, deep geological model was made based on drilling and actual underground face mapping data. • Small deviation between model made by core logging from drilling and face sampling is probably caused by survey accuracy and local "mine" grid rotation. • Vein domaining are made by geological model to classify high grade and low grade zone to produce robust mineral estimation. Based on geological logging, high grade zone correlated with Vein breccia, massive vein, and gouge clay at hanging wall, and low grade zone correlated with vein breccia and massive vein at foot wall area. • Prevoius model without domain are likely to be overestate the contained metal and not adequately reflect local grade variation. • Alternative model which made only from drilling data and comparing with actual face mapping, only show small deviation caused by pinching of

Criteria	JORC Code explanation	Cibaliung
		vein body, internal delusion, and survey accuracy. • Non geological domain which appliaed to Cikoneng & Cibitung vein caused several issue for density distribution and applying metallurgy propesties attibute to each domain. • Intrepetation of geological data from high quality surface mapping, trenches, drilling and underground face mapping and drilling have been used in developing geological and mineralization model and domain for estimation. • The complex interaction of multi phased structure and vein mineralization period form stockwork, breccia and massive quartz vein. Grade and geological continuity depend on the interplay of the mineralizing structure, preferred host and veinning intensity and the effect of later bounding and offsetting structures.
Dimensions	• The extent and variability of the Mineral Resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.	• The veins in Cibaliung Gold Mine have varying width between 1 m to 10 m, with 200 to 1,000 m length and 200 to 400 m dip direction
Estimation and modelling techniques	• The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domaining, interpolation parameters and maximum distance of extrapolation from data points. If a computer assisted estimation method was chosen include a description of computer software and parameters used. • The availability of check estimates, previous estimates and/or mine production records and whether the	• Estimation process using linear technique, for Cikoneng & Cibitung using ordinary krigging and the other using inverse distance estimator. • Declustering method was used for estimation of Cikoneng & Cibitung vein for reduce bias caused by clustered data distribution of face channeling. • The coefficient of variation in cikoneng & cibitung high grade zone averages 1.1, Confirming moderate complexity in grade distribution incorporating the

Criteria	JORC Code explanation	Cibaliung
	Mineral Resource estimate takes appropriate account of such data. • The assumptions made regarding recovery of by-products. • Estimation of deleterious elements or other non-grade variables of economic significance (eg sulphur for acid mine drainage characterisation). • In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed. • Any assumptions behind modelling of selective mining units. • Any assumptions about correlation between variables. • Description of how the geological interpretation was used to control the resource estimates. • Discussion of basis for using or not using grade cutting or capping. • The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available.	level of spatial and statistical complexity • An appropiate top cutting strategy was applied foe each domain based on statistical analysis using probability plot and meas & variance plot. • Intrepetation of geological data from high quality surface mapping, trenches, drilling and underground face mapping and drilling have been used in developing geological and mineralization model and domain for estimation. • To reduce bias when estimation of Cikoneng and Cibitung vein body, a domain was made based on gold grade distribution within the geological vein domain. 2 domain was made which is high grade zone (Au >2.5 gpt) and low grade zone (Au <2.5 gpt) • Interpolation parameter for Cikoneng & Cibitung were derived using standard exploratory data analysis teqhnique of statistical and continuity analysis. Appropiate interpolation strategies were developed on a domain basis using Krigging Neighborhood Analysis (KNA) which included; Block Size, Search elipsoid orientation and range, minimum & maximum samples, and optimum discrete • "Other than Cikoneng & Cibitung vein the estimation method used a composite data throughout the vein penetration. The grade estimation applied inverse distance weighting to the power of 2 (IDS) method with CAE Datamine Studio 3 software. Top cut has been applied to the estimation. Both grade control and resource estimation models use the same methodology. Estimates are routinely validated against production data where

Criteria	JORC Code explanation	Cibaliung
		available.The size of block is vein width 5 m x 2.5 m (tunnel blast) x 5 m (tunnel height). Maximum distance of extrapolation is 150 m x 150 m x 70 m. • Computer software used were: Surpac, Datamine, Microsoft office, & Supervisor • Prevoius estimated was made by AMC consulting. And compared with existing model. Lot of infill drilling was done after AMC BM report at 2004 • Actual mine vs BM estimate was made to measure the dillution and deviation • No further analysis regarding recovery of by-product • Appropiate block size, and search radius were derived from KNA analysis. • Selective Mining Unit was not applied during the modelling. • No assumption were made as gold and silver estimation. • Geological interpretation guided the creation of constraining mineralize vein body which use as hard boundary later. • Necessity for grade cutting was based on basis exploratory data analysis, including level of grade variability as expressed by the coefficient of variation. • Grade cutting completed on a domain basis on log normal probability plot and mean & variance plot, the grade distribution determine appropiate level of cutting to minimize the influence of outliner. • Check estimate using Ordinary Krigging and Inverse Distance were completed for Cikoneng & Cibitung vein for comparison. Estimated BM validated using Swath plot analysis, QQ plot, Histogram, and Probability plot

Criteria	JORC Code explanation	Cibaliung
		comparing actual and estimated OK & IDW data. • Variogram cross validation of several assumption based on variogram analysis were done before estimation to find a suitable variogram parameter. The attribute were analysis compare standard error, residual and slope regression between estimation and actual • Visual check of block model and actual data on several section. • Analysis of grade & tonnage curve distribution
Moisture	• Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.	• Tonnages are estimated both on wet and dry basis. Moisture was based on previous data to be 15%.
Cut-off parameters	• The basis of the adopted cut-off grade(s) or quality parameters applied.	• Cut of grade is derived from the economic parameters (price and cost). Price is assumed at $1458/oz. Other cost parameters refer to actual cash cost from historical data. The cut-off grade the applied in mineral resource estimate are 3 g/t Au.
Mining factors or assumptions	• Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential mining methods, but the assumptions made regarding mining methods and parameters when estimating Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the mining assumptions made.	• The Mineral Resource Estimate is reported constrained within an Underground Mine Design. Lower elevation is 850 and top elevation 1,200 meter.The boundary generally limited wih cut-off grades.

Criteria	JORC Code explanation	Cibaliung
Metallurgical factors or assumptions	• The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential metallurgical methods, but the assumptions regarding metallurgical treatment processes and parameters made when reporting Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the metallurgical assumptions made.	• Cibaliung has a conventional carbon in leach plant for recovery of gold and silver. The ore mineralogy of Mineral Resources in Cibaliung meet with the metallurgical requirements of this plant. • Based on the detailed chemical analyses, ore grade that applied above Cut-off Grade is possible to assess the metallurgical process.
Environmental factors or assumptions	• Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfields project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported. Where these aspects have not been considered this should be reported with an explanation of the environmental assumptions made.	• The using of crown pillar between surface and the tunnel roof to keep the surface safe from subsidence.
Bulk density	• Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples. • The bulk density for bulk material must have been measured by methods that adequately account for	• Bulk density was measured in many production tunnel front with chip channel sampling method. The in situ bulk density estimated at 2.62 ton/m3 and this value has been used across all the mineral deposit. • Density samples were wrapped using plastic and then wighted in both air and immersed in water • Given the distribution of the density samples, the density

Criteria	JORC Code explanation	Cibaliung
	void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit. • Discuss assumptions for bulk density estimates used in the evaluation process of the different materials.	values were assigned into Block Model and not estimated
Classification	• The basis for the classification of the Mineral Resources into varying confidence categories. • Whether appropriate account has been taken of all relevant factors (ie relative confidence in tonnage/grade estimations, reliability of input data, confidence in continuity of geology and metal values, quality, quantity and distribution of the data). • Whether the result appropriately reflects the Competent Person's view of the deposit.	• The mineral resource estimate has been classified as measured, indicated, and measuredon basis of range and krigging variance for Cikoneng and Cibitung • Initial classification was based on qualitative approach using; data support, confidence in domain interpretation, data quality and quality of estimate • Quantitative classification using geostatical simulation was used modify the initial classification involving; using coefficient variation and standard error from krigging estimation. • The main basis for the classification of the Mineral Resources outise of Cikoneng & Cibitung into varying confidence categories is the drillholes spacing, ore continuity, and production chip channel sampling. Inferred Resources are typically described greater than 70 m spacing, Indicated Resources from 30 – 70 spacing and Measured Resources lower than 30 m spacing. • The classification of the mineral resource estimation has taken into account all relevant factors throught a two stage qalitative and quantitative approach as described above • The result appropriately reflects the Competent Persons view of the deposit.
Audits or reviews	• The results of any audits or reviews of Mineral Resource estimates.	• The most recent independent review was conducted by AMC Consultants 2004 and Mining One

Criteria	JORC Code explanation	Cibaliung
		Consultans 2007. This review did not identify any material issues with the data inputs, resource estimate and process used in the estimate and concluded that the estimate had been prepared using good industry practice and has been appropriately classified.
Discussion of relative accuracy/ confidence	• Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors that could affect the relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	• The accuracy and confidence level of the mineral resources estimation is proved by comparing the estimated quality (tonnage, vein width, grades) of the mineral resources which is converted to ore reserves with actual production in the same position (coordinates and elevation), the comparison results are expressed by percent (%). • The comparison percentage statement between the estimation and the actual production is taken from global estimates which is resulted from average of local estimates of each actual production location. • Detailed monthly mine and mill reconciliations have been maintained since production commenced.

Table 1 - JORC Code, 2012 Edition

Section 4 Estimation and Reporting of Ore Reserves of **Cibaliung Prospect**

Criteria	JORC Explanation	Comment
Mineral Resources estimate for conversion to Ore Reserves	• Description of the Mineral Resources estimate used as a basis for the conversion to an Ore Reserves • Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of the Ore Reserves	• Mineral resources model are estimated by Geomin (ANTAM's exploration unit) • Ore Reserves estimate has been determined as part of and classified based on measured and indicated resources into proved and probable ore reserves • The measured and indicated gold resources are inclusive of those mineral resources modified to produce the ore reserves.
Site Visits	• Comment on any site visits undertaken by the Competent Person and the outcome of those visits. • If no site visits have been undertaken indicate why this is the case.	• Site visit done by Competent Person Team
Study Status	• The type and level of study undertaken to enable Mineral Resources to be converted to Ore Reserves. • The code requires that a study to at least Pre-Feasability Study level has been undertake to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable, and that material Modifying Factor have been considered.	• Feasibility Study
Cut-off parameters	• The basis of the adopted cut-off grade(s) or quality parameters applied.	• Cut of grade is derived from the economic parameters (price and cost). Price is assumed at $1458/oz. Other cost parameters refer to actual cash cost from historical data. COG for Cibaliung is 3 g/t
Mining factors or assumptions	• The method and assumptions used as reported in the Pre-Feasability Study or Feasability Study to convert the Mineral Resources to an Ore Reserves (i.e. either by application of appropiate factors by optimisation or by preliminary or detailed design). • The choice, nature and appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access. Etc. • The assumptions made regarding geotechnical parameters (eg pit slopes, stope sizes, etc) grade control and pre-production drilling	• Cibaliung mine applies cut and fill as mining method. The mine was optimised using MSO software. It was design using surpac software and schduled using minesched. • The primary underground access type is decline for main haulage and shaft for ventilation. • The mine is mostly composed of Rock Type of 2 and 3. • Mining Dilution at 5% • Mining Reovery at 100% • The Production Profile is 5x5 (Height xWidth) • The inferred mineral is not stated as reserve. However, if it is inclusive in

Criteria	JORC Explanation	Comment
	• The assumption made and Mineral Resources model used for pit and stope optimisation (if appropriate) • The Mining Dilution Factor Used • The Mining Recovery Factors Used • Any minimum mining widths used • The manner in which inferred Mineral Resources are utilisde in mining studies and the sensitivity of the outcome to their inclusion • The infrastructure requirements of the selected mining methods	the mine plan. It will be treated as waste material • 2019 statement : - Ore Tonnage of 1,844 KWmt @ 6.3 g/t Au to produce 306 Koz • Current statement (2020) : - Ore Tonnage of 610 KWmt @3.63 g/t to produce 56 Koz • The decrease of reserve from previous year is mainly caused by the new mine optimization and new parameter of estimation in resource model. In the previous year, it was stated that some orebody left as pillar was categorized as reserve. The study which involved the borehole in the mined out area was conducted to assert the status of this pillar. It resulted that the pillar can't be stated as reserve due to geotechnical issue and inapplicable current mining method to that orebody. Thus, in 2020, the ore body in the form of pillar is stated as resource.
Metallurgical factors or assumptions	• The metallurgical process proposed and the appropriateness of that process to the style of mineralisation • Whether the metallurgical process is well-tested technology or novel in nature • The nature, amount and representativeness of metallurgical test work undertaken the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied. • Any assumption or allowance made for deleterious elements • The existence of any bulk sample or pilotscale test work and the degree to which such samples are considered representative of the orebody as a whole • For minerals that are defined by a spesification, has the ore reserve estimation been based on the appropriate mineralogy to meet the spesifications	Processing Plant Recovery 90%
Environmental	• The status of studies of potential envinromental impacts of the mining and processing operation. Details of waste rock characterisation and the consideration of potential sites, status of design options considered and	• AMDAL has been approved by government

Criteria	JORC Explanation	Comment
	where applicable, the status of approvals for process residue storage and waste dumps should be reported	
Infrastructure	• The existence of appropriate infrastructure: availibility of land for plant development power, water, transportation (particulary for bulk commodities), labour, accommodation; or the ease with which the infrastructure can be provided or accessed	• Done
Costs	• The derivation of or assumptions made, regarding projected capital costs in the study • The methodology used to estimate operating costs • Allowances made for the content of deleterious elements • The source of exchange rates used in the study • Derivation of transportaion charges • The basis for forecasting or source of treatment and refining charges, penalties for failure to meet spesification, etc. • The allowances made for royalties payable, both Government and private	• Assumed from existing production data • Operating cost estimate by estimate production data • Assumed from existing production data • Exchange rates obtained assumption made in Antam's annual work plan and budget • Assumed from existing production data • Assumed from existing production data • The allowance of royalty has been considered
Revenue Factors	• The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc. • The derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.	• Metal price assumptions based on Antam's Forecast and Historical • Metal Price based LME Price cash seller ore price calculated with formula
Market assessment	• The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future. • A customer and competitor analysis along with the identification of likely market windows for the product. • Price and volume forecasts and the basis for these forecasts. • For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.	• Done • Done • Assumption made in Antam's work plan & budget • Have been considered
Economic	• The inputs to the economic analysis to produce the net present value (NPV) in	• Input parameter : ore price, selling cost, processing cost,

Criteria	JORC Explanation	Comment
	the study, the source and confidence of these economic inputs including estimated inflation, discount rate, etc. • NPV ranges and sensitivity to variations in the significant assumptions and inputs.	mining cost, mining dilution, mining recovery, annual discounting, and annual production rate • Done by various scenario
Social	• The status of agreements with key stakeholders and matters leading to social licence to operate.	• Done
Other	• To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves: • Any identified material naturally occurring risks. • The status of material legal agreements and marketing arrangements. • The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect that all necessary Government approvals will be received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third party on which extraction of the reserve is contingent.	• Done • Cash cost is the important factor because of scattered ore location • n/a • Done • No issues regarding to the mineral tenement status & government and statuory approvals.
Classification	• The basis for the classification of the Ore Reserves into varying confidence categories. • Whether the result appropriately reflects the Competent Person's view of the deposit. • The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).	• The classification of proven and probable ore reserve is based on the confidence categories of measured and indicated resources. Mining assumption is in line with these confidence levels. • n/a
Audits or reviews	• The results of any audits or reviews of Ore Reserve estimates.	
Discussion of relative accuracy/ confidence	• Where appropriate a statement of the relative accuracy and confidence level in the Ore Reserve estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the	• Acuracy could be improved by conducting robust operation monitoring • Annual mining plan is reviewed by comparing with ANTAM's annual work plan & budget • Commodity price, mining cost, and government's regulation give the biggest the impact for reserve estimation.

Criteria	JORC Explanation	Comment
	relative accuracy and confidence of the estimate. • The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. • Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage. • It is recognised that this may not be possible or appropriate in all circumstances. These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	• Mining reconciliation have been concluded to compare mine plan vs actual production

APPENDIX C — 2019 TIN RESERVES STATEMENT

Timah

2019

Tin Resources & Reserves Statement as per December 31, 2019

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Tin

This estimation report of resources and reserves both for alluvial and primary tin deposit has been checked and approved by a number of Competent Person Indonesia (CPI). The Competent Persons who get involved for alluvial tin deposit are Setiawan Raharjo, Ichwan Azwardi L, Satyogroho Dhian Amertho, Mustiko Aji, Riki Vernandes, Moh. Ciputra, Nofhy Gumelar. Then the Competent Persons who get involved for primary tin deposit are Satyogroho Dhian Amertho, Nofhy Gumelar, Angga Widya Yogatama, Ichwan Azwardi L, Alam Surya Pasemah, Nur Rochman Nabawi. The Competent Persons have prepared this report in accordance with the guidance of "Komite Cadangan Mineral Indonesia" (KCMI) code 2017 and have conducted site visits and observed all operational aspects onshore and offshore which includes exploration methods, mining, processing and smelting techniques.

The Report includes on the Reporting of the Results of Exploration, Estimation of Mineral Resources, and Estimation of Mineral Reserves of Primary and Alluvial Tin as well as tin associated minerals (MIT). The tin associated minerals are genetically formed along with tin bearing mineral.

Location

Exploration activities are located in Mining Permit Area owned by PT Timah Tbk. which are in Bangka Belitung Province, Riau Islands Province and Riau Province .

Figure 1. Location of PT Timah's Mining Permit Area.

Ownership

PT Timah Tbk has 127 of tin commodity concession which is known as The Mining Permit-Operation Production with a total area of 473,388.18 Ha, which spreaded over in 3 (three) regions namely Bangka Island, Belitung Island and Kundur-Karimun Islands which includes onshore and offshore, with the following details:

Figure 2. Situation Map of PT Timah's Mining Permit in Bangka

Table 1. Number and Area Size of Mining Permit.

Region	Onshore		Offshore	
	Number of IUP	Area (Ha)	Number of IUP	Area (Ha)
Bangka	79	235,692.65	19	108,752.83
Belitung	21	53,023.50	1	30,910.00
Karimun - Kundur	-	-	7	45,009.20
Total	**100**	**288,716.15**	**27**	**184,672.03**

Figure 3. Situation Map of PT Timah's Mining Permit in Belitung.

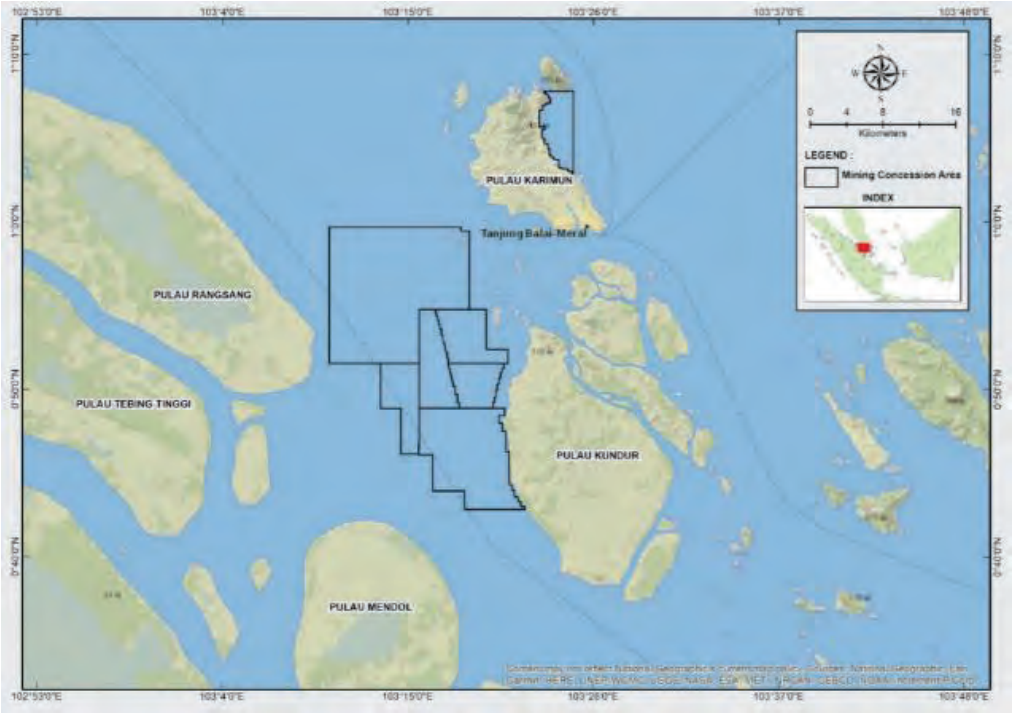


Figure 4. Situation Map of PT Timah's Mining Permit in Karimun - Kundur.

Table 2. Mining Permit (IUP) Decree PT Timah Tbk.

No	Decree Numbers	Region Code	Location	Concession Area	Area of Mining Permit (Ha)	Validity Period	
						Start	End
1	188.44/974/DPE/2016	1511	Bangka Induk, Kep. Bangka Belitung	Bubus - Belinyu	495.30	25-Oct-2016	20-Jul-2025
2	188.44/975/DPE/2016	1512	Bangka Induk, Kep. Bangka Belitung	Gunung Muda - Belinyu	8,731.00	25-Oct-2016	20-Jul-2025
3	188.44/989/DPE/2016	1513	Bangka Induk, Kep. Bangka Belitung	S. Sembuang - Belinyu	3,529.00	25-Oct-2016	20-Jul-2025
4	188.44/978/DPE/2016	1514	Bangka Induk, Kep. Bangka Belitung	A. Parak - Belinyu	52.41	25-Oct-2016	20-Jul-2025
5	188.44/995/DPE/2016	1515	Bangka Induk, Kep. Bangka Belitung	S. Simping - Belinyu	385.70	25-Oct-2016	20-Jul-2025
6	188.44/987/DPE/2016	1516	Bangka Induk, Kep. Bangka Belitung	S. Mapur - Belinyu	12,880.00	25-Oct-2016	20-Jul-2025
7	188.44/1009/DPE/2016	P0218/ eks.1517	Bangka Induk, Kep. Bangka Belitung	S. Lumut - Belinyu	25,910.00	25-Oct-2016	21-Jul-2027
8	188.44/1026/DPE/2016	1518 A	Bangka Induk, Kep. Bangka Belitung	S. Deniang - Sungailiat	3,939.00	25-Oct-2016	20-Jul-2025
9	188.44/1025/DPE/2016	1518 B	Bangka Induk, Kep. Bangka Belitung	S. Deniang - Sungailiat	837.60	25-Oct-2016	20-Jul-2025
10	188.45/457/Tamben/2010	1519	Bangka Induk, Kep. Bangka Belitung	Parit Padang - Sungailiat	207.00	27-Apr-2010	20-Jul-2025
11	188.44/984/DPE/2016	P0344/ eks.1520	Bangka Induk, Kep. Bangka Belitung	Parit Padang - Sungailiat	1,266.00	25-Oct-2016	17-Ags-2027
12	188.44/983/DPE/2016	1521	Bangka Induk, Kep. Bangka Belitung	Rebo Batu Ampar - Sungailiat	2,217.00	25-Oct-2016	20-Jul-2025
13	188.45/460/Tamben/2010	1522	Bangka Induk, Kep. Bangka Belitung	Merawang/ Kenanga	558.00	27-Apr-2010	20-Jul-2025
14	188.45/461/Tamben/2010	1523	Bangka Induk, Kep. Bangka Belitung	Jurung - Merawang	322.00	27-Apr-2010	20-Jul-2025
15	188.45/462/Tamben/2010	1548	Bangka Induk, Kep. Bangka Belitung	Lt. A. Kantung - Sungailiat	9,919.00	27-Apr-2010	20-Jul-2025
16	188.45/463/Tamben/2010	1555	Bangka Induk, Kep. Bangka Belitung	Lt. Deniang - Sungailiat	6,839.00	27-Apr-2010	20-Jul-2025
17	188.45/464/Tamben/2010	1559	Bangka Induk, Kep. Bangka Belitung	Lt. P. Danta - Belinyu	1,839.00	27-Apr-2010	20-Jul-2025
18	188.45/465/Tamben/2010	1560	Bangka Induk, Kep. Bangka Belitung	Lt. S. Belinyu - Belinyu	446.00	27-Apr-2010	20-Jul-2025
19	188.45/466/Tamben/2010	P0265/ eks. 1561	Bangka Induk, Kep. Bangka Belitung	Lt. Tg. Terentang Kelabat	713.00	27-Apr-2010	17-Aug-2027
20	188.45/467/Tamben/2010	1602	Bangka Induk, Kep. Bangka Belitung	A. Pugul - Belinyu	738.00	27-Apr-2010	20-Jul-2025
21	188.44/1030/DPE/2016	1484	Bangka Barat, Kep. Bangka Belitung	S. Kebiang - Jebus	1,049.00	25-Oct-2016	20-Jul-2025
22	188.44/1031/DPE/2016	1485 A 1	Bangka Barat, Kep. Bangka Belitung	S. Buluh Semulut	77.66	26-Oct-2016	20-Jul-2025
23	188.44/1008/DPE/2016	1485 A 2	Bangka Barat, Kep. Bangka Belitung	S. Buluh Semulut	6,898.00	25-Oct-2016	20-Jul-2025
24	188.44/1052/DPE/2016	1485 A 3	Bangka Barat, Kep. Bangka Belitung	S. Buluh Semulut	2,234.00	25-Oct-2016	20-Jul-2025
25	188.44/1001/DPE/2016	1485 A 4	Bangka Barat, Kep. Bangka Belitung	S. Buluh Semulut	296.40	25-Oct-2016	20-Jul-2025
26	188.44/1011/DPE/2016	1485 B 1	Bangka Barat, Kep. Bangka Belitung	Penganak - Cupat	546.70	25-Oct-2016	20-Jul-2025
27	188.44/1007/DPE/2016	1485 B 2	Bangka Barat, Kep. Bangka Belitung	Penganak - Cupat	1,763.00	25-Oct-2016	20-Jul-2025
28	188.44/1016/DPE/2016	1485 B 3	Bangka Barat, Kep. Bangka Belitung	Penganak - Cupat	1,248.00	25-Oct-2016	20-Jul-2025
29	188.44/1015/DPE/2016	1485 B 4	Bangka Barat, Kep. Bangka Belitung	Penganak - Cupat	470.10	25-Oct-2016	20-Jul-2025
30	188.44/1010/DPE/2016	1485 B 5	Bangka Barat, Kep. Bangka Belitung	Penganak - Cupat	255.80	25-Oct-2016	20-Jul-2025
31	188.44/378.H/ESDM/2017	1485 B 6	Bangka Barat, Kep. Bangka Belitung	Penganak - Cupat	97.89	29-Mar-2017	20-Jul-2025
32	188.44/1029/DPE/2016	1486	Bangka Barat, Kep. Bangka Belitung	S. Bembang - Jebus	680.30	25-Oct-2016	20-Jul-2025
33	188.45/071/2.03.02/2010	1487	Bangka Barat, Kep. Bangka Belitung	S. Petar - Jebus	2,567.19	28-Apr-2010	20-Jul-2025
34	188.44/1032/DPE/2016	1488	Bangka Barat, Kep. Bangka Belitung	S. Selimbang - Jebus	125.90	25-Oct-2016	20-Jul-2025
35	188.44/1031/DPE/2016	1489	Bangka Barat, Kep. Bangka Belitung	Tg. Pemuja - Jebus	124.90	25-Oct-2016	20-Jul-2025
36	188.44/1006/DPE/2016	1490 A	Bangka Barat, Kep. Bangka Belitung	Tg. Berhala - Mentok	154.50	25-Oct-2016	20-Jul-2025
37	188.44/1005/DPE/2016	1490 B	Bangka Barat, Kep. Bangka Belitung	Tg. Berhala - Mentok	59.58	25-Oct-2016	20-Jul-2025
38	188.44/1014/DPE/2016	1490 C	Bangka Barat, Kep. Bangka Belitung	Tg. Berhala - Mentok	79.71	25-Oct-2016	20-Jul-2025
39	188.44/1013/DPE/2016	1490 D	Bangka Barat, Kep. Bangka Belitung	Tg. Berhala - Mentok	23.59	25-Oct-2016	20-Jul-2025
40	188.44/1012/DPE/2016	1490 E	Bangka Barat, Kep. Bangka Belitung	Tg. Berhala - Mentok	182.10	25-Oct-2016	20-Jul-2025
41	188.44/973/DPE/2016	1491	Bangka Barat, Kep. Bangka Belitung	A. Biat - Mentok	1,032.00	25-Oct-2016	20-Jul-2025
42	188.44/1042/DPE/2016	1492	Bangka Barat, Kep. Bangka Belitung	S. Bendul - Mentok	921.60	25-Oct-2016	20-Jul-2025
43	188.44/1043/DPE/2016	1493	Bangka Barat, Kep. Bangka Belitung	A. Sukai - Mentok	1,950.00	25-Oct-2016	20-Jul-2025
44	188.44/1044/DPE/2016	1494	Bangka Barat, Kep. Bangka Belitung	Mayang/ A. Rambat - Mentok	3,800.00	25-Oct-2016	20-Jul-2025
45	188.44/1046/DPE/2016	1495	Bangka Barat, Kep. Bangka Belitung	S. Remunding - Mentok	657.60	25-Oct-2016	20-Jul-2025
46	188.44/1048/DPE/2016	1496	Bangka Barat, Kep. Bangka Belitung	S. Pelangas - Mentoka	391.90	25-Oct-2016	20-Jul-2025

No	Decree Numbers	Region Code	Location	Concession Area	Area of Mining Permit (Ha)	Validity Period	
						Start	End
47	188.45/081/2.03.02/2010	1497	Bangka Barat, Kep. Bangka Belitung	S. Berang - Mentok	2,654.88	28-Apr-2010	20-Jul-2025
48	188.45/082/2.03.02/2010	1498	Bangka Barat, Kep. Bangka Belitung	S. Menduyung - Mentok	2,709.66	28-Apr-2010	20-Jul-2025
49	188.45/083/2.03.02/2010	1499	Bangka Barat, Kep. Bangka Belitung	A. Sukal - Mentok	1,112.73	28-Apr-2010	20-Jul-2025
50	188.45/084/2.03.02/2010	1500	Bangka Barat, Kep. Bangka Belitung	A. Selang - Mentok	908.94	28-Apr-2010	20-Jul-2025
51	188.44/1049/DPE/2016	1501	Bangka Barat, Kep. Bangka Belitung	S. Terabik - Mentok	1,695.00	25-Oct-2016	20-Jul-2025
52	188.44/991/DPE/2016	1502	Bangka Barat, Kep. Bangka Belitung	A. Belo - Mentok	1,419.00	25-Oct-2016	20-Jul-2025
53	188.44/1037/DPE/2016	1503	Bangka Barat, Kep. Bangka Belitung	S. Gemuruh / S. Pait - Mentok	150.30	25-Oct-2016	20-Jul-2025
54	188.44/1041/DPE/2016	1504	Bangka Barat, Kep. Bangka Belitung	S. Daing - Mentok	51.34	25-Oct-2016	20-Jul-2025
55	188.44/1040/DPE/2016	1505	Bangka Barat, Kep. Bangka Belitung	S. Ketok - Mentok	617.00	25-Oct-2016	20-Jul-2025
56	188.44/1039/DPE/2016	1506	Bangka Barat, Kep. Bangka Belitung	A. Kundi / S. Sukal - Mentok	1,870.00	25-Oct-2016	20-Jul-2025
57	188.45/091/2.03.02/2010	P0222/ eks. 1507	Bangka Barat, Kep. Bangka Belitung	Medang / S. Jering - Mentok	1,986.70	28-Apr-2010	21-Jul-2027
58	188.45/092/2.03.02/2010	1508	Bangka Barat, Kep. Bangka Belitung	S. Muncung - Kelapa	4,753.27	28-Apr-2010	20-Jul-2025
59	188.44/1002/DPE/2016	1510	Bangka Barat, Kep. Bangka Belitung	Tempilang - Kelapa	54.60	25-Oct-2016	20-Jul-2025
60	188.44/1038/DPE/2016	P0220/ eks. 1544	Bangka Barat, Kep. Bangka Belitung	Tg. Nylur - Kelapa	1,115.00	25-Oct-2016	21-Jul-2027
61	188.45/096/2.03.02/2010	1545	Bangka Barat, Kep. Bangka Belitung	Lt. Tempilang - Kelapa	5,383.49	28-Apr-2010	20-Jul-2025
62	188.45/097/2.03.02/2010	1549	Bangka Barat, Kep. Bangka Belitung	Lt. Kebiong/Penganak - Jebus	15,050.00	28-Apr-2010	20-Jul-2025
63	188.45/098/2.03.02/2010	1551	Bangka Barat, Kep. Bangka Belitung	Lt. Bakit - Jebus	1,461.00	28-Apr-2010	20-Jul-2025
64	188.45/099/2.03.02/2010	1553	Bangka Barat, Kep. Bangka Belitung	Lt. Ranggam/Lt. Belo - Mentok	14,570.00	28-Apr-2010	20-Jul-2025
65	188.45/100/2.03.02/2010	1554	Bangka Barat, Kep. Bangka Belitung	Lt. Bendul - Mentok	4,644.20	28-Apr-2010	20-Jul-2025
66	188.45/214/DPE/2010	1533	Bangka Selatan, Kep. Bangka Belitung	Nyelanding / S. Ulin - Koba	10,660.00	30-Apr-2010	20-Jul-2025
67	188.45/215/DPE/2010	1534	Bangka Selatan, Kep. Bangka Belitung	Bedengung - Koba	1,307.00	30-Apr-2010	20-Jul-2025
68	188.44/982/DPE/2016	1535	Bangka Selatan, Kep. Bangka Belitung	Permis - Koba	991.00	25-Oct-2016	20-Jul-2025
69	188.45/346/DPE/2012	1536	Bangka Selatan, Kep. Bangka Belitung	Paku - Payung	5,199.00	07-Nov-2012	20-Jul-2025
70	188.45/218/DPE/2010	1537	Bangka Selatan, Kep. Bangka Belitung	Gadung - Toboali	979.70	30-Apr-2010	20-Jul-2025
71	188.44/1089/DPE/2016	1538	Bangka Selatan, Kep. Bangka Belitung	Tg. Kubu - Toboali	51.25	25-Oct-2016	20-Jul-2025
72	188.44/1021/DPE/2016	1539 A	Bangka Selatan, Kep. Bangka Belitung	Tg. Kemirai - Toboali	322.40	25-Oct-2016	20-Jul-2025
73	188.44/1050/DPE/2016	1539 B	Bangka Selatan, Kep. Bangka Belitung	Tg. Kemirai - Toboali	60.77	25-Oct-2016	20-Jul-2025
74	188.44/1051/DPE/2016	1539 C	Bangka Selatan, Kep. Bangka Belitung	Tg. Kemirai - Toboali	272.90	25-Oct-2016	20-Jul-2025
75	188.45/221/DPE/2010	1540	Bangka Selatan, Kep. Bangka Belitung	S. Kepoh - Koba	3,155.00	30-Apr-2010	20-Jul-2025
76	188.45/222/DPE/2010	1543	Bangka Selatan, Kep. Bangka Belitung	P. Lepar - Pongok	360.00	30-Apr-2010	20-Jul-2025
77	188.45/224/DPE/2010	1546	Bangka Selatan, Kep. Bangka Belitung	Lt. Toboali - Toboali	7,607.00	30-Apr-2010	20-Jul-2025
78	188.45/225/DPE/2010	P0221 / eks. 1547	Bangka Selatan, Kep. Bangka Belitung	Lt. Tg. Kubu - Toboali	4,403.00	30-Apr-2010	20-Jul-2025
79	188.45/347/DPE/2012	1601	Bangka Selatan, Kep. Bangka Belitung	Kepoh Cina - Toboali	547.80	07-Nov-2012	20-Jul-2025
80	188.45/172/DPE/2013	KP. PERMIS	Bangka Selatan, Kep. Bangka Belitung	Laut Permis	398.42	28-Feb-2013	27-Feb-2023
81	188.45/227/DPE/2010	KP. PERMIS B	Bangka Selatan, Kep. Bangka Belitung	Laut Permis	199.85	30-Apr-2010	12-Jun-2025
82	188.45/228/DPE/2010	KP. PERMIS C	Bangka Selatan, Kep. Bangka Belitung	Laut Permis	749.70	30-Apr-2010	12-Jun-2025
83	188.45/229/DPE/2010	KP. PERMIS D	Bangka Selatan, Kep. Bangka Belitung	Laut Permis	1,000.00	30-Apr-2010	22-May-2026
84	188.44/1028/DPE/2016	1526	Bangka Tengah, Kep. Bangka Belitung	Pedindang - S. Selan	689.40	25-Oct-2016	21-Jul-2025
85	188.44/1082/DPE/2016	1527	Bangka Tengah, Kep. Bangka Belitung	Kerakas/Keretak - S. Selan	4,262.00	25-Oct-2016	21-Jul-2025
86	541.16/052/IUP-OP/DPE/2010	1528	Bangka Tengah, Kep. Bangka Belitung	Sarangmandi - S. Selan	440.00	08-Apr-2010	21-Jul-2025
87	188.44/1047/DPE/2016	1530	Bangka Tengah, Kep. Bangka Belitung	Cambai - Namang	2,036.00	25-Oct-2016	21-Jul 2025
88	188.44/997/DPE/2016	1531	Bangka Tengah, Kep. Bangka Belitung	Kulur - Lubuk Besar	10,960.00	25-Oct-2016	21-Jul-2025
89	188.44/999/DPE/2016	1532	Bangka Tengah, Kep. Bangka Belitung	Padang Mulia - Koba	356.80	25-Oct-2016	21-Jul-2025
90	188.44/998/DPE/2016	1583	Bangka Tengah, Kep. Bangka Belitung	Kerakas - S. Selan	3,101.00	25-Oct-2016	21-Jul-2025
91	541.16/3656/DPE/2011	1584	Bangka Tengah, Kep. Bangka Belitung	Lt. Tg. Beriga - Lubuk Besar	5,039.17	11-May-2011	21-Jul-2025
92	188.44/977/DPE/2016	1605	Belitung, Kep. Bangka Belitung	A. Siluk - Siluk	823.20	25-Oct-2016	21-Jul-2025

No	Decree Numbers	Region Code	Location	Concession Area	Area of Mining Permit (Ha)	Validity Period	
						Start	End
93	188.44/1000/DPE/2016	PO232/Eks 1568 B	Belitung, Kep. Bangka Belitung	S.Membalong - Membalong	3,767.00	25-Oct-2016	20-Jul-2026
94	106/IUP-OP/DPE/2010	1603	Belitung, Kep. Bangka Belitung	A.Sengkeli - Sijuk/Badau	815.70	21-Jul-1995	21-Jul-2025
95	188.44/1019/DPE/2016	PO266/Eks 1569 A	Belitung, Kep. Bangka Belitung	Tg.Arabulan - Membalong	134.30	25-Oct-2016	21-Jul-2025
96	188.44/1018/DPE/2016	PO266/Eks 1569 B	Belitung, Kep. Bangka Belitung	Tg.Arabulan - Membalong	2,470.00	25-Oct-2016	21-Jul-2025
97	188.44/992/DPE/2016	1570	Belitung, Kep. Bangka Belitung	A.Belonsotan - Sijuk	308.70	25-Oct-2016	21-Jul-2025
98	188.44/1024/DPE/2016	PO232/Eks 1568 A	Belitung, Kep. Bangka Belitung	S.Membalong - Membalong	3,590.00	25-Oct-2016	20-Jul-2026
99	188.44/1027/DPE/2016	PO232/Eks 1568 C	Belitung, Kep. Bangka Belitung	S.Membalong - Membalong	1,307.00	25-Oct-2016	20 Jul 2026
100	188.44/1020/DPE/2016	1	Belitung, Kep. Bangka Belitung	S.Membalong - Membalong	46.90	25-Oct-2016	20-Jul-2026
101	188.44/985/DPE/2016	PO232/Eks 1568 C	Belitung Timur, Kep. Bangka Belitung	S. Pring - Kelapa Kampit	1,244.00	25-Oct-2016	27-Mar-2026
102	188.44/1023/DPE/2016	2	Belitung Timur, Kep. Bangka Belitung	S. Manggar - Manggar	5,915.00	25-Oct-2016	21-Jul-2025
103	188.44/1004/DPE/2016	P0228/ eks.1577	Belitung Timur, Kep. Bangka Belitung	S. Manggar - Manggar	6,408.00	25-Oct-2016	21-Jul-2025
104	188.44/986/DPE/2016	P0227/ eks.1576 A	Belitung Timur, Kep. Bangka Belitung	S. Manggar - Manggar	4,653.00	25-Oct-2016	21-Jul-2025
105	188.44/1017/DPE/2016	P0227/ eks.1576 B	Belitung Timur, Kep. Bangka Belitung	S. Manggar - Manggar	3,389.00	25-Oct-2016	21-Jul-2025
106	503/002/DP-L/BPMPT/2015	P0227/ eks.1576 C	Belitung Timur, Kep. Bangka Belitung	Lt. Manggar - Manggar	30,910.00	6-Feb-2015	21-Jul-2025
107	188.44/906/DPE/2015	P0227/ eks.1576 D	Belitung Timur, Kep. Bangka Belitung	A. Kunang - Lenggang	1,286.00	28-Aug-15	21-Jul-2025
108	188.44/976/DPE/2016	1562	Belitung Timur, Kep. Bangka Belitung	S. Senusa/Pesak - Lenggang	7,285.00	25-Oct-2016	21-Jul-2025
109	503/090/DP-L/BPPT/2010	1575	Belitung Timur, Kep. Bangka Belitung	Lenggang (Hematite)	175.00	02-Dec-1997	27-Mar-2026
110	188.44/993/DPE/2016	P0226/ eks.1574 P0320/ eks.1609	Linkab, Bangka Induk & Bangka Tengah, Kep. Bangka Belitung	Penagan - Mendo Barat	10,530.00	25-Oct-2016	20-Jul-2025
111	188.44/996/DPE/2016	1525	Linkab, Bangka Induk & Bangka Tengah, Kep. Bangka Belitung	S. Menduk - Mendo Barat	3,479.00	25-Oct-2016	20-Jul-2025
112	188.44/388/DPE/2010	P0223/eks 1550	Linkab, Bangka Induk & Bangka Barat, Kep. Bangka Belitung	Lt Cuoat - Belinyu	19,510.00	21-Jul-2009	20-Jul-2025
113	188.44/1022/DPE/2016	1509	Linkab, Bangka Induk & Bangka Barat, Kep. Bangka Belitung	Tempilang - Kelapa	4,156.78	25-Oct-2016	20-Jul-2025
114	188.44/990/DPE/2016	1529	Linkab, Bangka Tengah & Pangkalpinang, Kep. Bangka Belitung	Pangkol - Pangkalan Baru	4,362.00	25-Oct-2016	20-Jul-2025
115	188.44/393/DPE/2010	1556	Linkab, Bangka Tengah & Pangkalpinang, Kep. Bangka Belitung	Lt Sampur/Lt Kurau - Koba	8,981.00	21-Jul-2009	20-Jul-2025
116	188.44/988/DPE/2016	1541 blok A 1541 blok B	Linkab, Bangka Tengah & Bangka Selatan, Kep. Bangka Belitung	Toboali Selatan - Toboali (Blok A) Toboali Selatan - Toboali (Blok B)	29,629.00 26,970.00	25-Oct-2016	20-Jul-2025
117	188.44/994/DPE/2016	P0225/eks.1573	Linkab, Belitung & Beltim, Kep. Bangka Belitung	S.Cerucuk - Tg.Pandan	5,954.00	25-Oct-2016	20-Jul-2025
118	188.44/ /DPE/2016	P0230/eks.1578	Linkab, Belitung & Beltim, Kep. Bangka Belitung	S.Buding - Kelapa Kampit	607.70	21-Jul-2009	20-Jul-2025
119	188.44/385/DPE/2010	P0299/eks.1579	Linkab, Belitung & Beltim, Kep. Bangka Belitung	A.Jangkal - Kelapa Kampit	1,625.00	21-Jul-2009	20-Jul-2025
120	188.44/384/DPE/2010	P0231/eks.1580 Blok A	Linkab, Belitung & Beltim, Kep. Bangka Belitung	G.Tampong - Kelapa Kampit (Blok A)	413.30	21-Jul-2009	20-Jul-2025
		P0231/eks.1580 Blok B	Linkab, Belitung & Beltim, Kep. Bangka Belitung	G.Tampong - Kelapa Kampit (Blok B)	805.70	21-Jul-2009	20-Jul-2025
	Total area of mining permit in Bangka Belitung Islands Province				428,378.98		
121	No. 114 Tahun 2011	621	Karimun	Lt. Kobil - Kundur	10,475.00	11-May-2011	20-Jul-2025
122	No. 115 Tahun 2011	747D	Karimun	Lt. Pelambung – Karimun	2,740.00	11-May-2011	20-Jul-2025
123	No. 224 Tahun 2014	618 Blok B	Karimun	Lt. Timun Kundur Barat	3,251.00	06-Oct-2014	28-Apr-2020
124	No. 225 Tahun 2014	618 Blok C	Karimun	Lt. Timun Kundur Barat	2,409.00	06-Oct-2014	28-Apr-2020
125	1837/KPTS-18/IV/2018	618/RIAU	Kepulauan Riau	Lt. Timun - Kundur	3,426.00	03-Apr-2018	02-Apr-2023
126	1838/KPTS-18/IV/2018	KEPRI/Blok C	Kepulauan Riau	Lt. Kundur Barat	3,114.00	03-Apr-2018	02-Apr-2023
127	2928K/30/MEM/2011	P0264/ eks. 956	Lintas Propinsi, Kepri & Karimun	Lt. Kundur Barat - Kundur	19,594.20	14-Nov-2011	13-Nov-2026
	Total area of mining permit in Riau Islands and Riau Province				45,009.20		
	Total area of mining permit				473,388.18		

Resources Statement

The classification of tin resource blocks is based on the level of geological knowledge and confidence supported by geological models, interpolation parameters, drilling grids, surface position, and the number of drill holes.

Measured Resources:
The part of a mineral resources where volume, tonnage, densities, shape, physical characteristics, grade, and mineral content can be estimated with a high level of confidence.

Indicated Resources:
The part of a mineral resources where volume, tonnage, densities, shape, physical characteristics, grade, and mineral content can be estimated with reasonable level of confidence.

Inferred Resources:
The part of a mineral resources where tonnage, grade, and mineral content can be estimated with a low level of confidence.

Marginal Reserves:
The part of the mineral reserves that is determined as economically producible during feasibility studies but, as technical and economic factors still need to be considered during the mine planning, it returns to being classified as resources.

Unmineable Reserve:
The part of mineral reserves which was originally planned to be mined but, due to economic and technologic factors, it cannot be mined and returns to being classified as resources.

Tin estimation resources in PT Timah Tbk's IUPs is shown in Table 3 as follows:

Table 3. Total Tin Resources in Bangka, Belitung and Karimun - Kundur.

Category		Commodity	Ore Volume (m3)	Grade (Kg/m3)	Tonnage (TonSn)
Resources Classification	Measured	Alluvial Tin	2,073,438,159	0.19	389,980
	Indicated		845,091,906	0.08	68,080
	Inferred		1,249,383,214	0.14	171,080
Subtotal			**4,167,913,279**	**0.15**	**629,140**
Marginal Reserve *			**4,560,203,833**	**0.14**	**248,640**
Total			**8,728,117,112**	**0.10**	**877,780**
Category		**Commodity**	**Ore Tonnage (Ton)**	**Grade (%)**	**Tonnage (TonSn)**
Resources Classification	Measured	Primary Tin	13,241,535	0.21	28,300
	Indicated		18,986,079	0.17	33,000
	Inferred		46,389,276	0.21	96,700
Total			**78,616,891**	**0.20**	**158,000**

* Confident level of tonnage is only 40%

Alluvial Tin Resources Estimation and Statement

Summary of PT Timah Tbk's estimations for alluvial tin resources at Bangka, Belitung and Karimun-Kundur Island can be seen in Table 4 as follows :

Table 4. Total Alluvial Tin Resources in Bangka, Belitung, and Karimun - Kundur.

Location	Category		Ore Volume (m3)	Grade (Kg/m3)	Tonnage (TonSn)
Onshore	Resources Classification	Measured	255,206,425	0.20	52,120
		Indicated	95,650,468	0.09	8,720
		Inferred	844,942,877	0.17	143,090
Offshore	Resources Classification	Measured	1,818,231,734	0.19	337,860
		Indicated	749,441,438	0.08	59,360
		Inferred	404,440,337	0.07	27,990
Subtotal			**4,167,913,279**	**0.15**	**629,140**
Onshore	Marginal Reserve *		3,347,045,663	0.12	158,880
Offshore	Marginal Reserve *		1,213,158,170	0.19	89,760
Subtotal			**4,560,203,833**	**0.14**	**248,640**
Total			**8,728,117,112**	**0.10**	**877,780**

* Confident level of tonnage is only 40%

Table 5. Total Alluvial Tin Resources in Bangka.

Location	Category		Ore Volume (m3)	Grade (Kg/m3)	Tonnage (TonSn)
Onshore	**Resources Classification**	Measured	237,715,708	0.21	49,040
		Indicated	81,739,288	0.09	7,570
		Inferred	743,296,247	0.17	128,260
		Subtotal	**1,062,751,243**	**0.17**	**184,870**
	Marginal Reserve *		**2,650,463,612**	**0.13**	**139,880**
	Total		**3,713,214,855**	**0.09**	**324,750**
Offshore	**Resources Classification**	Measured	1,155,014,555	0.18	212,470
		Indicated	508,289,684	0.08	42,830
		Inferred	183,783,913	0.07	12,300
		Subtotal	**1,847,088,152**	**0.14**	**267,600**
	Marginal Reserve *		**715,824,145**	**0.21**	**60,120**
	Total		**2,562,912,297**	**0.13**	**327,720**
Total Alluvial Tin Resources in Bangka	**Resources Classification**	Measured	1,392,730,263	0.19	261,510
		Indicated	590,028,972	0.09	50,400
		Inferred	927,080,160	0.15	140,560
		Subtotal	**2,909,839,395**	**0.16**	**452,470**
	Marginal Reserve *		**3,366,287,757**	**0.15**	**200,000**
	Total		**6,276,127,152**	**0.10**	**652,470**

* Confident level of tonnage is only 40%

Table 6. Total Alluvial Tin Resources in Belitung.

Location	Category		Ore Volume (m3)	Grade (Kg/m3)	Tonnage (TonSn)
Onshore	**Resources Classification**	Measured	17,490,717	0.18	3,080
		Indicated	13,911,180	0.08	1,150
		Inferred	101,646,630	0.15	14,830
		Subtotal	**133,048,527**	**0.14**	**19,060**
	Marginal Reserve *		**696,582,051**	**0.07**	**19,000**
	Total		**829,630,578**	**0.05**	**38,060**
Offshore	**Resources Classification**	Measured	172,863,610	0.22	37,300
		Indicated	73,935,036	0.07	5,520
		Inferred	132,507,856	0.07	9,100
		Subtotal	**379,306,502**	**0.14**	**51,920**
	Marginal Reserve *		**26,029,313**	**0.07**	**720**
	Total		**405,335,815**	**0.13**	**52,640**
Total Alluvial Tin Resources in Belitung	**Resources Classification**	Measured	190,354,327	0.21	40,380
		Indicated	87,846,216	0.08	6,670
		Inferred	234,154,486	0.10	23,930
		Subtotal	**512,355,029**	**0.14**	**70,980**
	Marginal Reserve *		**722,611,364**	**0.07**	**19,720**
	Total		**1,234,966,393**	**0.07**	**90,700**

* Confident level of tonnage is only 40%

Table 7. Total Alluvial Tin Resources in Karimun-Kundur

Location	Category		Ore Volume (m3)	Grade (Kg/m3)	Tonnage (TonSn)
Total Alluvial Tin Resources in Kepulauan Riau	**Resources Classification**	Measured	490,353,569	0.18	88,090
		Indicated	167,216,718	0.07	11,010
		Inferred	88,148,568	0.07	6,590
		Subtotal	**745,718,855**	**0.14**	**105,690**
	Marginal Reserve *		**471,304,712**	**0.15**	**28,920**
	Total		**1,217,023,567**	**0.11**	**134,610**

* Confident level of tonnage is only 40%

Note :

- Domain interpretation on natural cut-off grade of 0.051 kg / m³ for alluvial.
- Statistical descriptive analysis is performed to determine the top cut limit which define the influence of very high grade
- Resources estimation system is based on the polygon method (Simple Reserves).
  The classification of insitu tin deposit resources consist of measured, indicated, and inferred resources.
- Resources classification of tin tailings deposited is categorized as measured, indicated and inferred resources as long as drilling is conducted
- The classification of tin deposit resources in the mined out area which based on interpretation of satellite imagery is classified as inferred resources.

- The classification of marginal reserves is based on the Guidelines for reporting exploration results, resources, and mineral reserves of the Indonesia National Standard (SNI) no. 4726 of 2019. The marginal reserves consist of unmined ore and residual ore.

Primary Tin Resources Estimation and Statement

Based on the activities of primary tin resources estimation in Bangka and Belitung Island by PT Timah Tbk, the following resources are obtained:

Table 8. Total Primary Tin Resources in Bangka and Belitung.

Location	Resources Classification	Ore Tonnage (Ton)	Grade (%)	Tonnage (TonSn)
Onshore	Measured	13,241,535	0.21	28,300
	Indicated	18,986,079	0.17	33,000
	Inferred	46,389,276	0.21	96,700
Total		**78,616,891**	**0.20**	**158,000**

Table 9. Total Primary Tin Resources in Bangka

Location	Resources Classification	Ore Tonnage (Ton)	Grade (%)	Tonnage (TonSn)
Onshore	Measured	3,349,248	0.02	700
	Indicated	7,659,299	0.05	4,100
	Inferred	28,221,455	0.17	48,600
	Total	**39,230,002**	**0.14**	**53,400**

Table 10. Total Primary Tin Resources in Belitung

Location	Resources Classification	Ore Tonnage (Ton)	Grade (%)	Tonnage (TonSn)
Onshore	Measured	9,892,288	0.28	27,600
	Indicated	11,326,781	0.26	28,900
	Inferred	18,167,820	0.26	48,100
	Total	**39,386,889**	**0.27**	**104,600**

Note :
- Statistical descriptive analysis was performed to determine the capping grade.
- Grade interpolation considers the position of mineralization from geological and geostatistical points of view.
- Estimation of the primary tin resources uses block model method.
- Micromine is the software used in estimation of the tin resources.

- The classification of tin deposit resources consists of measured, indicated, and inferred mineral resources.
- Specific gravity ranges between 2,67 – 3,28 gr/cc
- Cross Validation of data block model against layer grade assay.

Reserves Statement

Classification of Mineral Reserves blocks is part of Mineral Resources, where after applying all mining factors, the tonnage estimates and levels which, according to Competent Person Indonesia (CPI), can be the basis for determining project feasibility, after considering all the "Modifying Factors" that are relevant.

Proven Mineral Reserves:
The economically mineable part of a Measured Mineral Resource. A Proved Mineral Reserve implies a high degree of confidence in the Modifying Factors.

Probable Mineral Reserves:

The economically mineable part of an Indicated Resource and in some circumstances a part of a Measured Mineral Resource as well.

Reserves statements for all deposits are summarized in the Table 11 as follows:

Table 11. Total Tin Reserves in Bangka, Belitung, and Karimun - Kundur.

Category		**Commodity**	**Ore Volume (m3)**	**Grade (Kg/m3)**	**Tonnage (TonSn)**
Reserve Classification	Proven	Alluvial Tin	425,181,677	0.37	156,290
	Probable		374,344,086	0.31	116,430
Total			**799,525,763**	**0.34**	**272,720**
Category		**Commodity**	**Ore Tonnage (Ton)**	**Grade (%)**	**Tonnage (TonSn)**
Reserve Classification	Proven	Primary Tin	8,064,580	0.01	1,100
	Probable		26,989,363	0.20	53,700
Total			**35,053,942**	**0.16**	**54,800**

Alluvial Tin Reserves

Based on alluvial tin reserve estimation activities on Bangka, Belitung and Karimun - Kundur, the reserves is shown in Table 12.

Table 12. Total Alluvial Tin Reserves in Bangka, Belitung and Karimun-Kundur

Location	Reserve Classification	Ore Volume (m3)	Grade (Kg/m3)	Tonnage (TonSn)
Onshore	Proven	16,705,521	0.45	7,590
	Probable	28,702,489	0.38	10,950
	Subtotal	**45,408,010**	**0.41**	**18,540**
Offshore	Proven	408,476,156	0.36	148,700
	Probable	345,641,597	0.31	105,480
	Subtotal	**754,117,753**	**0.34**	**254,180**
Total	Proven	425,181,677	0.37	156,290
	Probable	374,344,086	0.31	116,430
	Subtotal	**799,525,763**	**0.34**	**272,720**

Table 13. Total Alluvial Tin Reserves in Bangka

Location	Reserve Classification	Ore Volume (m3)	Grade (Kg/m3)	Tonnage (TonSn)
Onshore	Proven	14,764,155	0.44	6,460
	Probable	27,172,604	0.38	10,240
	Subtotal	**41,936,759**	**0.40**	**16,700**
Offshore	Proven	241,750,333	0.40	96,890
	Probable	187,033,431	0.29	53,580
	Subtotal	**428,783,764**	**0.35**	**150,470**
Total Alluvial Tin Reserve in Bangka	Proven	256,514,488	0.40	103,350
	Probable	214,206,035	0.30	63,820
	Total	**470,720,523**	**0.36**	**167,170**

Table 14. Total Alluvial Tin Reserves in Belitung

Location	Reserve Classification	Ore Volume (m3)	Grade (Kg/m3)	Tonnage (TonSn)
Onshore	Proven	1,941,366	0.58	1,130
	Probable	1,529,885	0.46	710
	Subtotal	**3,471,251**	**0.53**	**1,840**
Offshore	Proven	0	0.00	0
	Probable	112,596,250	0.30	34,130
	Subtotal	**112,596,250**	**0.30**	**34,130**
Total Alluvial Tin Reserve in Belitung	Proven	1,941,366	0.58	1,130
	Probable	114,126,135	0.31	34,840
	Total	**116,067,501**	**0.31**	**35,970**

Table 15. Total Alluvial Tin Reserves in Karimun-Kundur

Location	Reserve Classification	Ore Volume (m3)	Grade (Kg/m3)	Tonnage (TonSn)
Total Alluvial Tin Reserve in Kepulauan Riau	Proven	166,725,823	0.31	51,810
	Probable	46,011,916	0.39	17,770
	Total	**212,737,739**	**0.33**	**69,580**

Primary Tin Reserves Statements

Based on the activities of primary tin reserve estimation on Bangka and Belitung Islands, the reserves is reflected in Table 16:

Table 16. Total Primary Tin Reserves in Bangka and Belitung.

Location	Reserve Classification	Ore Tonnage (Ton)	Grade (%)	Tonnage (TonSn)
Onshore	Proven	8,064,580	0.01	1,100
	Probable	26,989,363	0.20	53,700
	Total	**35,053,942**	**0.16**	**54,800**

Table 17. Total Primary Tin Reserves in Bangka

Location	Reserve Classification	Ore Tonnage (Ton)	Grade (%)	Tonnage (TonSn)
Onshore	Proven	8,064,580	0.01	1,100
	Probable	13,387,478	0.03	4,600
	Total	**21,452,057**	**0.03**	**5,700**

Table 18. Total Primary Tin Reserves in Belitung

Location	Reserve Classification	Ore Tonnage (Ton)	Grade (%)	Tonnage (TonSn)
Onshore	Proven	-	-	-
	Probable	13,601,885	0.36	49,100
	Total	**13,601,885**	**0.36**	**49,100**

Note :

- Only measured and indicated mineral resources are included in the estimated mineral reserves.
- The illegal mining area, Minimum mining area and depth of excavation were taken into account..
- Production forest areas that already have Leasehold of Forest Area License (IPPKH) are proven to be included.

- Break Even Grade (BEG) based on Mining operations and Marketing units.
- The average metal price for 2019 is USD 17,200 which is used as a basis to determine the Break Even Grade (BEG).
- Cultivation Rights Title (HGU) Area, Public Facilities, Reef, River, and Shipping Channel were taken into account

Associated Minerals of Tin

Alluvial tin deposit exploration includes estimates of cassiterite and other associated minerals. By geological model, the drilling and estimation technique for associated minerals of tin is similar to tin, but the sampling technique and laboratory analysis do not comply with the reporting code. We estimate, the tonnage of associated tin minerals as part of tin resources blocks.

Associated tin minerals resources statements in PT Timah Tbk concession can be seen in the following Table 19 :

Table 19. Associated Minerals of Tin related to location.

Location	Ore Volume (m3)	Monazite		Zircon		Ilmenite	
		Grade (Kg/m3)	Tonnage (ton)	Grade (Kg/m3)	Tonnage (ton)	Grade (Kg/m3)	Tonnage (ton)
Onshore	1,195,799,770	0.002	1,890	0.025	29,740	0.010	12,410
Offshore	2,972,113,509	0.001	2,990	0.007	21,300	0.017	50,330
Total	**4,167,913,279**	**0.001**	**4,880**	**0.012**	**51,040**	**0.015**	**62,740**

Table 20. Associated Minerals of Tin related to location in Bangka

Location	Ore Volume (m3)	Monazite		Zircon		Ilmenite	
		Grade (Kg/m3)	Tonnage (ton)	Grade (Kg/m3)	Tonnage (ton)	Grade (Kg/m3)	Tonnage (ton)
Onshore	1,062,751,243	0.002	1,820	0.026	28,090	0.010	10,850
Offshore	1,847,088,152	0.001	2,270	0.008	14,260	0.012	22,030
Total	**2,909,839,395**	**0.001**	**4,090**	**0.015**	**42,350**	**0.011**	**32,880**

Table 21. Associated Minerals of Tin related to location in Belitung

Location	Ore Volume (m3)	Monazite		Zircon		Ilmenite	
		Grade (Kg/m3)	Tonnage (ton)	Grade (Kg/m3)	Tonnage (ton)	Grade (Kg/m3)	Tonnage (ton)
Onshore	133,048,527	0.001	70	0.012	1,650	0.012	1,560
Offshore	379,306,502	0.001	220	0.010	3,670	0.040	15,190
Total	**512,355,029**	**0.001**	**290**	**0.010**	**5,320**	**0.033**	**16,750**

Table 22. Associated Minerals of Tin related to location in Karimun-Kundur

Location	Ore Volume (m3)	Monazite		Zircon		Ilmenite	
		Grade (Kg/m3)	Tonnage (ton)	Grade (Kg/m3)	Tonnage (ton)	Grade (Kg/m3)	Tonnage (ton)
Onshore	-	-	-	-	-	-	-
Offshore	745,718,855	0.001	500	0.005	3,370	0.018	13,110
Total	**745,718,855**	**0.001**	**500**	**0.005**	**3,370**	**0.018**	**13,110**

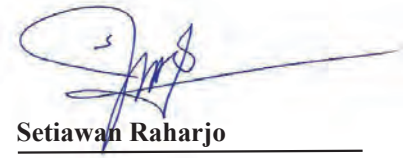
Appendix I

Signature and Approval of Competent Person

APPROVAL

I agree to provide the Tin Estimated Resources and Estimated Approval Report and Statement :

PT TIMAH Tbk



Setiawan Raharjo Date : **February 7, 2020**
Competent Person

Professional Membership
Indonesian Mineral Reserves Committee : Member Number : 0601892-29

Satyogroho Dhian Amerto Date : **February 7, 2020**
Competent Person

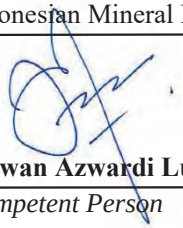
Professional Membership
Indonesian Mineral Reserves Committee : Member Number : CPI-123

Nohfy Gumelar Nurdaen Date : **February 7, 2020**
Competent Person

Professional Membership
Indonesian Mineral Reserves Committee : Member Number : CPI-163

Angga Widya Yogatama Date : **February 7, 2020**
Competent Person

Professional Membership
Indonesian Mineral Reserves Committee : Member Number : CPI-162

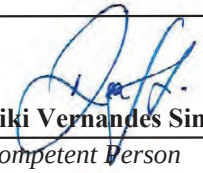


Ichwan Azwardi Lubis Date : **February 7, 2020**
Competent Person

Professional Membership
Indonesian Mineral Reserves Committee : Member Number : 0601870-153

Mustika Aji Date : **February 7, 2020**
Competent Person

Professional Membership
Indonesian Mineral Reserves Committee : Member Number : 1705111-169

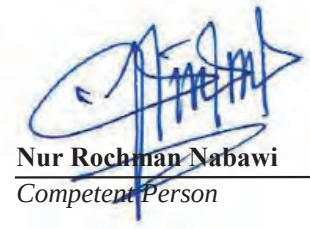


Riki Vernandes Simanjuntak Date : **February 7, 2020**
Competent Person

Professional Membership
Indonesian Mineral Reserves Committee : Member Number : 1805224-171

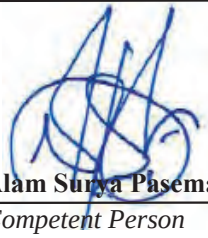
Mohamad Ciputra Date : **February 7, 2020**
Competent Person

Professional Membership
Indonesian Mineral Reserves Committee : Member Number : 1805341-170



Nur Rochman Nabawi Date : **February 7, 2020**
Competent Person

Professional Membership
Indonesian Mineral Reserves Committee : Member Number :CPI-179 /2019



Alam Surya Pasemah Date : **February 7, 2020**
Competent Person

Professional Membership
Indonesian Mineral Reserves Committee : Member Number : CPI -180 /2019

Appendix II

Competent Person Approval Form

COMPETENT PERSON APPROVAL FORM

VERIFICATION AND REPORTING OF EXPLORATION RESULT, RESOURCES AND RESERVE RESOURCES OF PT TIMAH Tbk PERIOD OF DECEMBER 31st 2019

PT TIMAH Tbk

Alluvial Tin Deposits

February 7th, 2020

Statement

I am,

Setiawan Raharjo

Confirming that I have competentency in the area of expertise Reporting Exploration Result (PHE), Estimation of Mineral Resources and Reserves (ESCM) for Alluvial Tin deposit for this report and :

- I have read and understood the requirements of the Indonesian Exploration Results, Mineral Resources and Ore Reserves Reporting Code requirements (2017 KCMI Code)
- I am a Competent Person with PHE & ESM expertise as defined by the 2017 KCMI Code, has more than five years experience relevant to the type of mineralization and type of deposit as described in the Report and related activities that could be accounted for
- As a member of the Indonesian Mining Expert Association (PERHAPI) and the Indonesian Geologist Association (IAGI)
- I have reviewed the report for which this Agreement Statement applies

I am an employee of PT **Timah Tbk**

The report based, for the period ending December 31st, 2019

Statement

I am,

Ichwan Azwardi Lubis

Confirming that I have competentency in the area of expertise Estimation of Mineral Reserves (ECM) for Alluvial Tin deposit for this report and :

- I have read and understood the requirements of the Indonesian Exploration Results, Mineral Resources and Ore Reserves Reporting Code requirements (2017 KCMI Code)
- I am a Competent Person with ECM expertise as defined by the 2017 KCMI Code, has more than five years experience relevant to the type of mineralization and type of deposit as described in the Report and related activities that could be accounted for
- As a member of the Indonesian Mining Expert Association (PERHAPI)
- I have reviewed the report for which this Agreement Statement applies

I am an employee of **PT Timah Tbk**

The report based, for the period ending December 31st, 2019

Statement

I am,

Mustika Aji

Confirming that I have competentency in the area of expertise Estimation of Mineral Reserves (ECM) for Alluvial Tin deposit for this report and :

- I have read and understood the requirements of the Indonesian Exploration Results, Mineral Resources and Ore Reserves Reporting Code requirements (2017 KCMI Code)
- I am a Competent Person with ECM expertise as defined by the 2017 KCMI Code, has more than five years experience relevant to the type of mineralization and type of deposit as described in the Report and related activities that could be accounted for
- As a member of the Indonesian Mining Expert Association (PERHAPI)
- I have reviewed the report for which this Agreement Statement applies

I am an employee of **PT Timah Tbk**

The report based, for the period ending December 31st, 2019

Statement

I'm,

Riki Vernandes Simanjuntak

Confirming that I have competentency in the area of expertise Estimation of Mineral Reserves (ECM) for Alluvial Tin deposit for this report and :

- I have read and understood the requirements of the Indonesian Exploration Results, Mineral Resources and Ore Reserves Reporting Code requirements (2017 KCMI Code)
- I am a Competent Person with ECM expertise as defined by the 2017 KCMI Code, has more than five years experience relevant to the type of mineralization and type of deposit as described in the Report and related activities that could be accounted for
- As a member of the Indonesian Mining Expert Association (PERHAPI)
- I have reviewed the report for which this Agreement Statement applies

I am an employee of **PT Timah Tbk**

The report based, for the period ending December 31st, 2019

Statement

I'm,

Mohamad Ciputra

Confirming that I have competentency in the area of expertise Estimation of Mineral Reserves (ECM) for Alluvial Tin deposit for this report and :

- I have read and understood the requirements of the Indonesian Exploration Results, Mineral Resources and Ore Reserves Reporting Code requirements (2017 KCMI Code)
- I am a Competent Person with ECM expertise as defined by the 2017 KCMI Code, has more than five years experience relevant to the type of mineralization and type of deposit as described in the Report and related activities that could be accounted for
- As a member of the Indonesian Mining Expert Association (PERHAPI)
- I have reviewed the report for which this Agreement Statement applies

I am an employee of **PT Timah Tbk**

The report based, for the period ending December 31st, 2019

Statement

I'm,

Satyogroho Dhian Amertho

Confirming that I have competentency in the area of expertise Estimation of Mineral Resources (ESM) for Alluvial Tin deposit for this report and:

- I have read and understood the requirements of the Indonesian Exploration Results, Mineral Resources and Ore Reserves Reporting Code requirements (2017 KCMI Code)
- I am a Competent Person with ESM expertise as defined by the 2017 KCMI Code, has more than five years experience relevant to the type of mineralization and type of deposit as described in the Report and related activities that could be accounted for
- As a member of the Indonesian Mining Expert Association (PERHAPI)
- I have reviewed the report for which this Agreement Statement applies

I am an employee of **PT Timah Tbk**

The report based, for the period ending December 31st, 2019

COMPETENT PERSON APPROVAL FORM

VERIFICATION AND REPORTING OF EXPLORATION RESULT, RESOURCES AND RESERVE RESOURCES OF PT TIMAH Tbk PERIOD OF DECEMBER 31st 2019

PT TIMAH Tbk

Primary Tin Deposit

February 7th, 2020

Statement

I'm,

Setiawan Raharjo

Confirming that I have competentency in the area of expertise Reporting Exploration Result (PHE) for Primary Tin deposit for this report and ;

- I have read and understood the requirements of the Indonesian Exploration Results, Mineral Resources and Ore Reserves Reporting Code requirements (2017 KCMI Code)
- I am a Competent Person with PHE expertise as defined by the 2017 KCMI Code, has more than five years experience relevant to the type of mineralization and type of deposit as described in the Report and related activities that could be accounted for
- As a member of the Indonesian Mining Expert Association (PERHAPI) and the Indonesian Geologist Association (IAGI)
- I have reviewed the report for which this Agreement Statement applies

I am an employee of PT **Timah Tbk**

The report based, for the period ending December 31st, 2019

Statement

I'm,

Satyogroho Dhian Amertho

Confirming that I have competentency in the area of expertise Estimation of Mineral Resources (ESM) for Primary Tin deposit for this report and:

- I have read and understood the requirements of the Indonesian Exploration Results, Mineral Resources and Ore Reserves Reporting Code requirements (2017 KCMI Code)
- I am a Competent Person with ESM expertise as defined by the 2017 KCMI Code, has more than five years experience relevant to the type of mineralization and type of deposit as described in the Report and related activities that could be accounted for
- As a member of the Indonesian Mining Expert Association (PERHAPI)
- I have reviewed the report for which this Agreement Statement applies

I am an employee of **PT Timah Tbk**

The report based, for the period ending December 31st, 2019

Statement

I'm,

Nofhy Gumelar Nurdaen

Confirming that I have competentency in the area of expertise Estimation of Mineral Resources (ESM) for Primary Tin deposit for this report and:

- I have read and understood the requirements of the Indonesian Exploration Results, Mineral Resources and Ore Reserves Reporting Code requirements (2017 KCMI Code)
- I am a Competent Person with ESM expertise as defined by the 2017 KCMI Code, has more than five years experience relevant to the type of mineralization and type of deposit as described in the Report and related activities that could be accounted for
- As a member of the Indonesian Mining Expert Association (PERHAPI)
- I have reviewed the report for which this Agreement Statement applies

I am an employee of **PT Timah Tbk**

The report based, for the period ending December 31st, 2019

Statement

I'm,

Angga Widya Yogatama

Confirming that I have competentency in the area of expertise Reporting Exploration Result (PHE) for Primary Tin deposit for this report and ;

- I have read and understood the requirements of the Indonesian Exploration Results, Mineral Resources and Ore Reserves Reporting Code requirements (2017 KCMI Code)
- I am a Competent Person with PHE expertise as defined by the 2017 KCMI Code, has more than five years experience relevant to the type of mineralization and type of deposit as described in the Report and related activities that could be accounted for
- As a member of the Indonesian Mining Expert Association (PERHAPI) and the Indonesian Geologist Association (IAGI)
- I have reviewed the report for which this Agreement Statement applies

I am an employee of PT **Timah Tbk**

The report based, for the period ending December 31st, 2019

Statement

I'm,

Ichwan Azwardi Lubis

Confirming that I have competentency in the area of expertise Estimation of Mineral Reserve (ECM) for Primary Tin deposit for this report and ;

- I have read and understood the requirements of the Indonesian Exploration Results, Mineral Resources and Ore Reserves Reporting Code requirements (2017 KCMI Code)
- I am a Competent Person with ECM expertise as defined by the 2017 KCMI Code, has more than five years experience relevant to the type of mineralization and type of deposit as described in the Report and related activities that could be accounted for
- As a member of the Indonesian Mining Expert Association (PERHAPI) and the Indonesian Geologist Association (IAGI)
- I have reviewed the report for which this Agreement Statement applies

I am an employee of PT **Timah Tbk**

The report based, for the period ending December 31st, 2019

Statement

I am,

Nur Rochman Nabawi

Confirming that I have competentency in the area of expertise Reporting Exploration Result (PHE) for Primary Tin deposit for this report and ;

- I have read and understood the requirements of the Indonesian Exploration Results, Mineral Resources and Ore Reserves Reporting Code requirements (2017 KCMI Code)
- I am a Competent Person with PHE expertise as defined by the 2017 KCMI Code, has more than five years experience relevant to the type of mineralization and type of deposit as described in the Report and related activities that could be accounted for
- As a member of the Indonesian Mining Expert Association (PERHAPI) and the Indonesian Geologist Association (IAGI)
- I have reviewed the report for which this Agreement Statement applies

I am an employee of PT **Timah Tbk**

The report based, for the period ending December 31st, 2019

Statement

I am,

Alam Surya Pasemah

Confirming that I have competentency in the area of expertise Reporting Exploration Result (PHE) for Primary Tin deposit for this report and ;

- I have read and understood the requirements of the Indonesian Exploration Results, Mineral Resources and Ore Reserves Reporting Code requirements (2017 KCMI Code)
- I am a Competent Person with PHE expertise as defined by the 2017 KCMI Code, has more than five years experience relevant to the type of mineralization and type of deposit as described in the Report and related activities that could be accounted for
- As a member of the Indonesian Mining Expert Association (PERHAPI) and the Indonesian Geologist Association (IAGI)
- I have reviewed the report for which this Agreement Statement applies

I am an employee of PT **Timah Tbk**

The report based, for the period ending December 31st, 2019

Appendix III

Check List of Assessment and Reporting Criteria

(with reference to Table 1 of KCMI Code)

Check List of Assessment and Reporting Criteria

Alluvial Tin Deposit

No	Criteria	Explanation	Commentary
		Sampling Techniques and Data (criteria in this group apply to all succeeding groups)	
1	Sampling techniques	Nature and quality of sampling (e.g. cut channels, random chips etc.) and measures taken to ensure representativeness of the samples	Sample was done by systematically drilling activities that consist of 551,313 holes for Bangka area, 109,192 holes for Belitung area and 41,542 holes for Kundur area with structured drilling.
2	Drilling techniques	Drill type (e.g. core, reverse circulation, open-hole hammer, rotary air blast, auger, Bangka etc.) and details (e.g. core diameter, triple or standard tube, depth of diamond tails, face-sampling bit or other type, whether core is oriented and if so, by what method, etc).	Onshore drilling was carried out using a Bangka drill which could penetrated up to a depth of 30 meters, as well as a mechanical drill with a 4-inch diameter casing that could drilled to a depth of 60 meters. Offshore drilling was carried out with a counter flush technique on drilling vessels with a pipe diameter of 2-14 inches. It could drilled up to a depth of 120 meters. All drilling was implemented vertically to reach optimally maximum intersection against relatively horizontal mineralized zones.
3	Drill sample recovery	Whether core and chip sample recoveries have been properly recorded and results assessed	Sampling applied from 1961 - 2019. Drilling samples was recorded per 1m. Per each sample intervals was panned to produce heavy associated minerals.
		Measures taken to maximize sample recovery and ensure representative nature of the samples	Onshore drilling for relatively soft material was performed by dry drilling mechanism. While for shallow offshore drilling was operated by dropping a pipe in dry condition to avoid contaminations. To obtain representative sample, it required 1 meter of drilling interval.
		Whether a relationship exists between sample recovery and	Nonoptimal volume of samples recovery would affect

No	Criteria	Explanation	Commentary
		grade and whether sample bias may have occurred due to preferential loss/gain of fine/coarse material.	the grade for each level drilling interval. On offshore drilling was necessary to put the sample filters with 20mm and 70mm sizes which were suitable for the samples characteristic. Therefore the loss of fine tin minerals was likely to occur only in the panning process
4	Logging	Whether core and chip samples have been logged to a level of detail to support appropriate Mineral Resource estimation, mining studies and metallurgical studies	Drilling log has been created and it was necessary to make some measurent within all drilling activities. It was including geological logging at the drilling site as well as detailed lithological descriptions and inputted it into the database.
		Whether logging is qualitative or quantitative in nature. Core (or trench, channel etc.) photography.	Logging was undertaken quantitatively for each drill intervals. Observations were appplied including lithology, mineralization, and physical characteristics for each sample.
5	Sub-sampling techniques and sample preparation	If core, whether cut or sawn and whether quarter, half or all core taken	Drilling samples were cutting material. All samples were accepted in a wet condition, then the samples were panned to extract the concentrate of the ore. Then the concentrate was analyzed using the grain counting analysis (GCA) method by a microscope in the laboratory of PT. Timah, Tbk.
		If non-core, whether riffled, tube sampled, rotary split etc. and whether sampled wet or dry	
		For all sample types, the nature, quality and appropriateness of the sample preparation technique	All samples were taken out and panned to produce the heavy minerals concentrate and as well as the light minerals.
		Quality control procedures adopted for all sub-sampling stages to maximize the representativeness of the samples	PT. Timah, Tbk's laboratory had been verified by the laboratory which was independent and accredited
		Measures taken to ensure that the sampling is representative of the in situ material collected	The method which was applied to distribute the grain size was performed by using a sieve shaker with sizes of +48 mesh, -48 +100 mesh and -100 mesh .
		Whether sample sizes are appropriate to the grain size of the material being sampled.	
		A statement as to the security measures taken to ensure sample integrity is recommended	Each concentrate sample is stored in a storage. It was placed there within the time limitation that as per the applied protocols
6	Quality of assay data	The nature, quality and appropriateness of the assaying and	Levels of analysis were carried out using a microscope

No	Criteria	Explanation	Commentary
	and laboratory tests.	laboratory procedures used and whether the technique is considered partial or total	with the Grain Counting Analysis (GCA) method of bone concentrate. All samples containing pasiran are analyzed. The analysis was carried out by the procedure: sample acceptance, execution, weighing, screening and microscopy analysis. Wet chemical analysis procedures such as sample reception, pulverizing and pulverizing, weighing, digestion and titration.
		Nature of quality control procedures adopted (e.g. standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (i.e.. lack of bias) and precision have been established	The sample assaying was implemented by Grain Counting Analysis (GCA) method. All the sandy material must be analyzed. And the procedure of analysis were made by a anumber of step. It were sample registration, drying, weighing, shieving, and then run the microscope analysis. While for wet chemical analysis, it had some stages also, i.e ; sample registration, pulverizing, weighing, digestation and finally titration.
7	Verification of sampling and assaying.	The verification of significant intersections by either independent or alternative company personnel	The verification was performed by visiting to drilling site and directly observed the drilling process that was taken on place.
		The use of twinned holes.	
8	Location of data points.	Accuracy and quality of surveys used to locate drill holes (collar and down-hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation	The position data collection or determination of X, Y, Z position was used the cross-line method and paid satellite with a maximum accuracy of 0.5 meters.
		Quality and adequacy of topographic control	The topographical control activity was eperformed by using Bench Mark point (BM) which was widely distributed within PT Timah Tbk's concessions.
9	Data spacing and distribution.	Data spacing for reporting of Exploration Results	Drillings were done with spaces of 100x200m (geology), 100x100m and 50x100m (prospecting), and 50x50m (detailed)
		Whether the data spacing and distribution is sufficient to establish the degree of geological and grade continuity appropriate for the Mineral Resource and Mineral Reserve estimation procedure(s) and classifications applied.	The drilling spaces and distribution of data within the PT Timha Tbk’s concession were sufficient to calculate the resources and reserves and to classify them as well.
		Whether sample compositing has been applied.	No composite samples were used in the assaying.

No	Criteria	Explanation	Commentary
			Sampling was done for every interval of 1 meter.
10	Reporting Archives	Documentation of primary data, data entry procedures, data verification, data storage (physycal and electronic) for preparing the report	The physical data was stored in the file cabinets, and while the electronic data is inputted into the exploration database of PT. Timah, Tbk
11	Orientation of data in relation to geological structure.	Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type.	All drillholes had an orientation toward tin deposit position which was extended horizontally. All drilling had vertically direction.
		If the relationship between the drilling orientation and the orientation of key mineralized structures is considered to have introduced a sampling bias, this should be assessed and reported if material	There was no data orientation that created bias sampling
12	Audits or reviews	The results of any audits or reviews of sampling techniques and data.	It has been carried out an assessment of the sampling method by a competent person in order to increase the confident level of data so that the data was feasible to perform the resources estiomation process
Reporting Exploration Results (Criteria in this group apply to all succeeding groups)			
13	Mineral rights and land ownership	Type, reference name/number, location and ownership including agreements or material issues with third parties such as joint ventures, partnerships, overriding royalties, native title interests, historical sites, wilderness or national park and environmental settings	The resource and reserve estimation project was carried out on PT Timah Tbk's Mining License (IUP) with Production Operation (OP) status. The IUP was spreaded out in Bangka, Belitung, and Kundur Island. The IUP of PT. Timah, Tbk has an area of 288,729 m2 for onland and of 84,672 m2 for offshore. Total IUP that was belonged to PT. Timah, Tbk, is 100 of IUP for onland and 27 of IUP for offshore
		The security of the tenure held at the time of reporting along with any known impediments to obtaining a license to operate in the area	The validity time of PT Timah Tbk's IUP is until July 2025
		Location plans of mineral rights and titles. It is not expected that the descritpiton of mineral title in a technical report should be a legal opinion but should be a brief and clear description of such title as understood by the author.	The legality that was related to PT Timah Tbk's IUP was issued by the Ministry of Energy and Mineral Resources (ESDM) of the Republic of Indonesia.
14	Exploration done by	Acknowledgment and appraisal of exploration by other	The entirely IUP of PT Timah, Tbk had been validated

No	Criteria	Explanation	Commentary
	other parties.	parties.	by Micromine Pty in 2007, LAPI ITB in 2010 and 2017, and by PT Greenland Resources in 2013
15	Geology	Deposit type, geological setting and style of mineralization.	The alluvial tin deposits in IUP of PT Timah Tbk were quarter alluvium deposits geologically and Quarter old. They were controlled by the avaibility of sources, denudational processes, transportation processes and finally they were deposited in an ancient channel. The presence of sea level fluctuations during the quarter period causes some alluvial tin deposits to be deposited in the sea.
		Reliable geological maps and cross sections should exist to support interpretations.	
16	Data aggregation methods.	In reporting Exploration Results, weighting averaging techniques, maximum and/or minimum grade truncations (e.g. cutting of high grades) and cut-off grades are usually material and should be stated	For the typical alluvial tin deposits applicated 0.051 kg / m3, for the cut off grade. The outlier grades value would be capped.
		Where aggregate intercepts incorporate short lengths of high-grade results and longer lengths of low grade results, the procedure used for such aggregation should be stated and some typical examples of such aggregations should be shown in detail.	The applied interval aggregation was a long low-grade interval by compiling all data assays in one hole (Whole of Hole).
		The assumptions used for any reporting of metal equivalent values should be clearly stated	The resource estimate referred to the historical price of the highest tin metal, which was USD 33,200 / ton, with the lowest cut-off grade value was 0.051 kg / m3.
17	Relationship between mineralization widths and intercept lengths	These relationships are particularly important in the reporting of Exploration Results.	The drilling penetration interval length was according to actual thickness of the tin mineralization.
		If the geometry of the mineralization with respect to the drill hole angle is known, its nature should be reported	
		If it is not known and only the down-hole lengths are reported, there should be a clear statement to this effect (e.g. „downhole length, true width not known").	
18	Diagrams	Where possible, maps and sections (with scales) and	For maps, cross sections, and drilling lists could be seen

No	Criteria	Explanation	Commentary
		tabulations of intercepts should be included for any material discovery being reported if such diagrams significantly clarify the report	in the reports.
19	Balanced reporting	Where comprehensive reporting of all Exploration Results is not practicable, representative reporting of both low and high grades and/or widths should be practiced to avoid misleading reporting of Exploration Results.	The Exploration Result Report (PHE) was able to perform entirely and it can be seen on the report content.
20	Other substantive exploration data.	Other exploration data, if meaningful and material, should be reported including (but not limited to): geological observations; geophysical survey results; geochemical survey results; bulk samples – size and method of treatment; metallurgical test results; bulk density, groundwater, geotechnical and rock characteristics; potential deleterious or contaminating substances.	All basic exploration data had been included within the report content
21	Further work.	The nature and scale of planned further work (e.g. tests for lateral extensions or depth extensions or large-scale step-out drilling).	The next planned activity was to put some additional drillholes (infill drilling) on the location that had a low geological confidence.
Estimation and Reporting of Mineral Reserves (Criteria listed in the first group, and where relevant in other preceding groups, apply also to this group)			
22	Database integrity.	Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes	The Competent person had done validation process to the database in order to confirm the suitability between collar data with assay data.
		Data validation procedures used.	Comparing both collar and assay data by checking whether any data duplication, missing interval and empty interval length by using the micromine 2020's software
23	Site visit	CPI must include a Commentary on the results of the field visit.	The site visit had been performed with the result that it could be followed up for resources & reserve estimation process.
		In condition where a field visit is not performed then give the excuse	Site visit was done
24	Geological	Confidence in (or conversely, the uncertainty of) the	The confidence level for ore continuity was made based

No	Criteria	Explanation	Commentary
	Interpretation.	geological interpretation of the mineral deposit.	on density of drilling sample data with refer to variography analysis.
		Nature of the data used and of any assumptions made.	The data which applied to geological correlation was consisted of stratigraphy, grade analysis and by performing of geostatistical method..
		The effect, if any, of alternative interpretations on Mineral Resource estimation	There was no applicated alternative interpretation
		The use of geology in guiding and controlling Mineral Resource estimation	The type of lithology was used as the controller to determinate a grade based domain.
		The factors affecting continuity both of grade and geology.	The affected factor for grade and geology continuity was stratigraphy and geological environment
25	Dimensions	The extent and variability of the Mineral Resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource	The thickness and length of tin ore body in each block was variated. It depended on with the type of deposit. The explanation related with this issue was included within the report content.
26	Estimation and modelling techniques	The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domain, interpolation parameters, maximum distance of extrapolation from data points.	Grade capping was performed for extreme value according with statistical analysis. The maximum extrapolation from data point was half of the drill spacing
		The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data	The previously resources estimation had been finished by PT Timah Tbk on period up to December 31st 2018
		The assumptions made regarding recovery of by-products	By-product minerals as tin associated minerals (i.e monazite, ilmenite and zircon) was estimated with referring to tin mineralization
		Estimation of deleterious elements or other non-grade variables of economic significance (e.g. sulphur for acid mine drainage characterization).	There was no impurities element that can be affected to mining feasibility
		In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed.	The resources estimation of tin alluvial were applied polygon method (simple reserve). The average onshore drillholes spacing were 40 m with 2 accuracy point for measured resources, 80 m with 5 accuracy point for indicated resources and 120 m with 5 accuracy point for

No	Criteria	Explanation	Commentary
			inferred resources. Meanwhile the average offshore drillhole spacing were 50 m with 2 accuracy point for measured resources, 100 m with 5 accuracy point for indicated resources and 150 m with 5 accuracy point for inferred resources.
		Any assumptions behind modelling of selective mining units	There was no assumption to Selective Mining Unit (SMU)
		Any assumptions about correlation between variables	It was applied statistical software to make inter variable correlation.
		The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available	The modelling validation and estimation was performed by comparing between average original weighted grade with estimation grade.
		Detailed description of the method used and the assumptions made to estimate tonnages and grades (section, polygon, inverse distance, geostatistical, or other method	The statistical method was implemented to identify drilling data properties and the geostatistical method was performed too to recognize data continuity. Data interpolation was run by the polygonal method (simple reserve).
		Description of how the geological interpretation was used to control the resource estimates.	The geological interpretation was applied to know the boundary of paeochannel and finnaly it was useful to determined the boundary block of resources . The minimum grade as the cut off grade for the block of resources was 0.051 kg/m3.
		Discussion of basis for using or not using grade cutting or capping. If a computer method was chosen, description of programmes and parameters used.	The capping of highest grade was done based on statistical analysis of Micromine software 2020
		Geostatistical methods are extremely varied and should be described in detail. The method chosen should be justified. The geostatistical parameters, including the variogram, and their compatibility with the geological interpretation should be discussed. Experience gained in applying geostatistics to similar deposits should be taken into account	The applied geostatistical method was the variography method which was for identifying the grade continuity between the data. It was also for as a searching radius of the resources classification.
27	Moisture	Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the	The tonnage was estimated on dry condition.

No	Criteria	Explanation	Commentary
		moisture content	
28	Cut-off parameters.	The basis of the adopted cut-off grade(s) or quality parameters applied.	Cut-off grade was applied by considering economy aspect. The implemented assumption was referring to tin price at $33.200 USD/Ton
29	Mining factors or assumptions.	Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It may not always be possible to make assumptions regarding mining methods and parameters when estimating Mineral Resources. Where no assumptions have been made, this should be reported	The mining assumption used open pit method for onland, meanwhile it used dredging ship and suction dredging ship for offshore. The applied parameters were mining cost, mining recovery, mining dilution, metal tin price forecasting and royalty.
		In order to demonstrate realistic prospects for eventual economic extraction, basic assumptions are necessary. Examples include access issues (shafts, declines, etc.), geotechnical parameters (pit slopes, stope dimensions etc.), infrastructure,requirements and estimated mining costs. All assumptions should be clearly stated	
30	Metallurgical factors or assumptions	The basis for assumptions or predictions regarding metallurgical amenability. It may not always be possible to make assumptions regarding metallurgical treatment processes and parameters when reporting Mineral Resources. Where no assumptions have been made, this should be reported	The estimated tin ores were extractable metalurgically
31	Bulk Density	Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples	The bulk density measurement had been represented by each sample grade of tin deposit. All grade values were reported as unit kg/m3 which especially had the same unit with bulk density.
32	Classification.	The basis for the classification of the Mineral Resources into varying confidence categories	The applied resources classification were based on drillholes spacing which determined by geostatistical method
		Whether appropriate account has been taken of all relevant factors. i.e. relative confidence in tonnage/grade computations, confidence in continuity of geology and metal values, quality, quantity and distribution of the data	All relevant factor had been taken into account and had been approved by competent person

No	Criteria	Explanation	Commentary
		Whether the result appropriately reflects the CPI"s view of the deposit	The resources estimation had been discussed, modified and accepted by competent person
33	Audits or reviews.	The results of any audits or reviews of Mineral Resource estimates.	The audit and review had been performed internally. The implementation of statistical and geostatistical procedure had applicated for the resources estimation and the confident level of data as well. All of them were reflected on the resources reporting
34	Discussion of relative accuracy/confidence .	Where appropriate a statement of the relative accuracy and/or confidence in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person Indonesia. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate	Comparing the mining realization with the estimation results was still done at each the end of the mining activity and was set forth in the mining progress report.
		The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages or volumes, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used	The resources statement was reported for each IUP as per the the value of cut off grade
		These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	Comparing the mining realization with the estimation results was still done at each the end of the mining activity and was set forth in the mining progress report.
Estimation and Reporting of Mineral Reserves (criteria listed in the first group, and where relevant in other preceding groups, apply also to this group)			
35	Mineral Resource estimate for conversion to Mineral Reserves.	Description of the Mineral Resource estimate used as a basis for the conversion to a Mineral Reserve	Only the indicated and measured resources that were able to convert as mineral reserves.
		Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Mineral Reserves	The reported ore reserves were a part of mineral resources

No	Criteria	Explanation	Commentary
36	Site visit	CPI must include a Commentary on the results of the field visit	The Competent Persons for alluvial tin commodity had visited to some locations of PT Timah Tbk's alluvial tin mining block
		In condition where a field visit is not performed then give the excuse	The site visit had been done
37	Study status.	The type and level of study undertaken to enable Mineral Resources to be converted to Mineral Reserves.	PT Timah Tbk had operated mining that was still active. Some assumed parameters for converting the resources to the reserves were based on recently actual data. The data was considered reasonable for Pre/Feasibility Study
		The Code does not require that a final feasibility study has been undertaken to convert Mineral Resources to Mineral Reserves, but it does require that at least Pre-Feasibility level will have determined a mine plan that is technically achievable and economically viable, and that all Modifying Factors have been considered	
38	Cut-off parameters.	The basis of the cut-off grade(s) or quality parameters applied.	The cut off grades for alluvial tin mining were appropriated with the applied mining class.
39	Mining factors or assumptions.	The method and assumptions used to convert the Mineral Resource to a Mineral Reserve (i.e. either by application of appropriate factors by optimization or by preliminary or detailed design).	The onland mining methods were assumed to use conventional truck shovels and suction pumps. While the offshore mining methods were assumed to use Dredge Ship, Suction Dredging Ship, Suction Ponton Ship, Cutter Suction Dredgers (CSD) and Borehole Mining (BHM). Pit Optimizing that processed by Micromine 2020 software was applied to make pit boundary with some constraints were ▪ Mining costs of $ 2-3 /m³ ▪ 70-90% for mining recovey ▪ 4% for dilution ▪ Tin price is is $ 17,200 / ton ▪ Royalty of 3%
		The choice of, the nature and the appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc	
		The assumptions made regarding geotechnical parameters (e.g. pit slopes, stope sizes, etc.), grade control and pre-production drilling	
		The major assumptions made and Mineral Resource model used for pit optimization (if appropriate)	
		The mining dilution factors, mining recovery factors, and minimum mining widths used	
		The infrastructure requirements of the selected mining	

No	Criteria	Explanation	Commentary
		methods.	
40	Metallurgical factors or	The metallurgical process proposed and the appropriateness of that process to the style of mineralization	The mineral processing recovery that reached out 98,57% was originated from Tin Ore Processing Plant (PPBT) recovery and Smelting Plant data that ranging from 2013-2019.
		Whether the metallurgical process is well-tested technology or novel in nature.	
		The nature, amount and representativeness of metallurgical test work undertaken and the metallurgical recovery factors applied	
		Any assumptions or allowances made for deleterious elements.	
		The existence of any bulk sample or pilot scale test work and the degree to which such samples are representative of the orebody as a whole.	
41	Cost and revenue factors.	The derivation of, or assumptions made, regarding projected capital and operating costs.	The assumption of applied capital cost were based on infrastructure, mining equipment, and mineral processing which were used for each mining site. The revenue calculation was based on the grade of tin concentrate and the tin metal price at $17.200/ton
		The assumptions made regarding revenue including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, etc.	
		The allowances made for royalties payable, both Government and private	
42	Market assessment.	The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future.	PT Timah Tbk's tin metals were basically international commodities which the weight quantity, Sn content and the impurity had met with London Metal Exhange's regulation PT Timah Tbk sold tin metal products to the big scale customers. Meanwhile PT Timah Tbk empowered its subsidiary which was domiciled at UK for small scale customers. PT Timah Tbk also operated marketing strategies by selling the downstream products and solder. The sold downstream product was in the form of tin alloy and tin chemical.
		A customer and competitor analysis along with the identification of likely market windows for the product	
		Price and volume forecasts and the basis for these forecasts	
		For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.	

No	Criteria	Explanation	Commentary
43	Other.	The effect, if any, of natural risk, infrastructure, environmental, legal, marketing, social or governmental factors on the likely viability of a project and/or on the estimation and classification of the Mineral Reserves	PT Timah Tbk stated that the status of agreement with government and substantial approval for project continuity such as concession status was entirely in good performance.
		The status of titles and approvals critical to the viability of the project, such as mining leases, discharge permits, government and statutory approvals.	By enactment of Regulation of the Minister of Trade of the Republic of Indonesia Number 32 of 2013 was concerning Tin Export Provision that obliged one-door policy for the exporting of tin metal. The door should went through the Indonesia Commodity & Derivatives Exchange (ICDX or BKDI). Therefore PT Timah Tbk asked all their big scale customers to join as the member of ICDX in order to get directly access for tin metal product.
44	Classifications	The basis for the classification of the Mineral Reserves into varying confidence categories.	Mineral Reserves Estimation was referred to Mineral Resources Estimation that been classified as "Indicated" or "Measured" all totally after considered all aspect of mining, metallurgy, social, environment and finance.
		Whether the result appropriately reflects the CPI"s view of the deposit.	
		The proportion of Probable Mineral Reserves, which have been derived from Measured Mineral Resources (if any).	The proven mineral reserves was converted from measured resources. Meanwhile the probable mineral reserves was converted from indicated resources.
45	Audits or reviews.	The results of any audits or reviews of Mineral Reserve estimates	Additional review or audit is still undergoing
46	Discussion of relative accuracy/confidence	Where appropriate a statement of the relative accuracy and/or confidence in the Mineral Reserve estimate using an approach or procedure deemed appropriate by the Competent Person Indonesia. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate	Confidence relativity for reserves estimation was reflected within the reserves report for proven and probable category as per KCMI 20217 code. Report making for reserves was held by internal team of PT Timah Tbk which was controlled and supervised by Competent Persons so that the independency was well maintained
		The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages or	The reserves was reported either globally or for each concession. The result of detailed reserves estimation

No	Criteria	Explanation	Commentary
		volumes, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used.	was provided in locally scale as an addition for entire of project
		These statements of relative accuracy and confidence of the estimate should be compared with production data, where available	The operation of PT Timah Tbk had taken place for a long time that included exploration activity, mining, production and marketing. All the aspects have been considered for reserves estimation process.

Primary Tin Deposit

No	Criteria	Explanation	Commentary
Sampling Techniques and Data (criteria in this group apply to all succeeding groups)			
1	Sampling techniques	Nature and quality of sampling (e.g. cut channels, random chips etc.) and measures taken to ensure representativeness of the samples	The samples was taken from drilling activity for each resources block areas. They were in Pemali as many as 318 holes, in Paku as many as 104 holes, Tempilang as many as 65 holes and Batubesi as many as 156 holes.
2	Drilling techniques	Drill type (e.g. core, reverse circulation, open-hole hammer, rotary air blast, auger, Bangka etc.) and details (e.g. core diameter, triple or standard tube, depth of diamond tails, face-sampling bit or other type, whether core is oriented and if so, by what method, etc).	The drilling used diamond drill core, with triple tube diameter was 2 - 3.5 inch. The orientating drilling core was held by spear method
3	Drill sample recovery	Whether core and chip sample recoveries have been properly recorded and results assessed	The drilling sample was started by 1983 until 2019. The drilling recovery was recorded per lithology break, with the average recovery was above 95%
		Measures taken to maximize sample recovery and ensure representative nature of the samples	To maximize the confident level, a more careful sampling was performed on the intensively fracturing zone that had the bigger potential risk of sample losses as on the mineralization zone
		Whether a relationship exists between sample recovery and grade and whether sample bias may have occurred due to	There was a relationship between sample recovery with the grade of mineralization zone. It was no bias since

No	Criteria	Explanation	Commentary
		preferential loss/gain of fine/coarse material.	the cutting sample was not used for resources estimation process. And the cutting was noted on the borelog
4	Logging	Whether core and chip samples have been logged to a level of detail to support appropriate Mineral Resource estimation, mining studies and metallurgical studies	For drilling registration had been performed the recording and measurement for all drilling activity, including geological logging at drilling site, alteration, mineralization, detailed geological structure and then all of them was inputted into database.
		Whether logging is qualitative or quantitative in nature. Core (or trench, channel etc.) photography.	Logging was held quantitatively for each core interval. The observation was performed for lithology, mineralization, physical properties per sample, also equipped with core photo / image samples.
5	Sub-sampling techniques and sample preparation	If core, whether cut or sawn and whether quarter, half or all core taken	The drilling sample was in the shape of drilling core. The sample was taken a half of it to be prepared. Then the other half was storaged as filing of geological data. The sample was prepared in dry condition, pulverized by hammer mill. Then the sample was homogenized by mollen mill. Hereinafter, the sample was divided into 4 parts by friffle splitter. Sample then was grinded and more than 95% sample was finer than mesh# 200. Furthermore, the sample was analyzed with XRF Desktop that used press pellets method at PT Timah Tbk's laboratory. To ensure that the quality of sample was maintained, quality control was done by putting standard sample on every batch analysis. Blank sample, duplicate sample, and replicate sample were put as form of quality control. The allowed tolerancy was 2 times of deviation standard of average standard sample. Besided that Laboratory of PT Timah Tbk performed the assaying check routinely by comparing with the accreditated independent laboratory.
		If non-core, whether riffled, tube sampled, rotary split etc. and whether sampled wet or dry	
		For all sample types, the nature, quality and appropriateness of the sample preparation technique	
		Quality control procedures adopted for all sub-sampling stages to maximize the representativeness of the samples	
		Measures taken to ensure that the sampling is representative of the in situ material collected	
		Whether sample sizes are appropriate to the grain size of the material being sampled.	
		A statement as to the security measures taken to ensure sample integrity is recommended	
6	Quality of assay data	The nature, quality and appropriateness of the assaying and	The assaying analysis was applied to all samples by

No	Criteria	Explanation	Commentary
	and laboratory tests.	laboratory procedures used and whether the technique is considered partial or total	XRF that used the press pellet method. The analysis was held at the Laboratory of PT Timah Tbk
		Nature of quality control procedures adopted (e.g. standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (i.e.. lack of bias) and precision have been established	Quality control of assay analysis was applied by using standard samples, blank samples, duplicate samples, and replicate samples. Besided that Laboratory of PT Timah Tbk performed the assaying check routinely by comparing with the accreditated independent laboratory. The deviation result was still in tolerated zone
7	Verification of sampling and assaying.	The verification of significant intersections by either independent or alternative company personnel	The laboratory analysis process to verify the results of the assaying was held by entrusting a number of samples to the other independent laboratory. It would be applicated as a comparison and the quality control. The drill holes verification was carried out by PT. Antam, Tbk, which is a member of the Mining Industry Holding, under the supervision of the Exploration Division of PT. Timah, Tbk.
		The use of twinned holes.	Twin drilling was not carried out since the sample quality control was considered as a representative thing
8	Location of data points.	Accuracy and quality of surveys used to locate drill holes (collar and down-hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation	The X, Y, Z data acquisition was applied with the terrestrial survey method with a maximum of 0.5 m deviation. The downhole survey was done with Proshot Gen 4 for every multiple of 25 meters depth in each drillhole
		Quality and adequacy of topographic control	The topography measurement was done with the UAV & USV method. Pengukuran topografi dilakukan dengan menggunakan metode UAV dan USV. Reference point used Bench Mark (BM) and Ground Control Point (GCP) method with the minimum required point was 6 GCP per block. The terrestrial method was implemented as the control for the UAV method. The allowed tolerance was below 0,5 m.
9	Data spacing and	Data spacing for reporting of Exploration Results	Drilling activity was held with 100x200 m drillholes

No	Criteria	Explanation	Commentary
	distribution.		spacing for geological stage, 100x100 m for prospection stage and 50x50 m for detailed stage
		Whether the data spacing and distribution is sufficient to establish the degree of geological and grade continuity appropriate for the Mineral Resource and Mineral Reserve estimation procedure(s) and classifications applied.	The drillholes spacing and data distribution had been met the requirement for geological confidence and grade continuity. The closely distribution of data spacing and distribution reflected the level of geological confidence and more higher grade. The study of data distribution used the variography for the resources estimation. The area with unclosely data distribution and spacing was allocated as the inferred resources
		Whether sample compositing has been applied.	The process of compositing data was done to determine the mineralization zone and then the compositing data was applied to resources estimation.
10	Reporting Archives	Documentation of primary data, data entry procedures, data verification, data storage (physycal and electronic) for preparing the report	The physical data was storaged on filing storage. While electronic data was inputted into exploration database of PT. Timah, Tbk.
11	Orientation of data in relation to geological structure.	Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type.	The determination of the location of the drilling point, azimuth, and the drilling inclination were performed by considering the shape of the deposit body, direction of the deposit, and the plunge of the deposit. The orientation of the sample is held by using the spear method.
		If the relationship between the drilling orientation and the orientation of key mineralized structures is considered to have introduced a sampling bias, this should be assessed and reported if material	
12	Audits or reviews	The results of any audits or reviews of sampling techniques and data.	An assessment of the sampling technique was supervised by a competent person to increase the level of data confidence which was matched for resource estimation.
Reporting Exploration Results (Criteria in this group apply to all succeeding groups)			
13	Mineral rights and land ownership	Type, reference name/number, location and ownership including agreements or material issues with third parties such as joint ventures, partnerships, overriding royalties,	Estimation of resources and reserves was carried out at the location of the Production Operation Mining License (IUP-OP) that owned by PT. Timah, Tbk. It

No	Criteria	Explanation	Commentary
		native title interests, historical sites, wilderness or national park and environmental settings	was located in the Pemali, Paku, Tempilang, and Batubesi blocks with IUP number P0218 / ex. 1517, 1536, 1509 and P0227 / ex. 1576 A.
		The security of the tenure held at the time of reporting along with any known impediments to obtaining a license to operate in the area	The validity time of PT Timah Tbk's IUP-OP for Paku, Tempilang, and Batubesi area until July 2025. Meanwhile Pemali area (P0218/eks. 1517) has validity time until July 2027.
		Location plans of mineral rights and titles. It is not expected that the descritpiton of mineral title in a technical report should be a legal opinion but should be a brief and clear description of such title as understood by the author.	The legality that related with mining license that had been issued by Ministry of Energy and Mineral Resources (ESDM) of the Republic of Indonesia.
14	Exploration done by other parties.	Acknowledgment and appraisal of exploration by other parties.	The entirely IUP of PT Timah, Tbk had been validated by Micromine Pty in 2007, LAPI ITB in 2010 and 2017, and by PT Greenland Resources in 2013
15	Geology	Deposit type, geological setting and style of mineralization.	On primary tin deposits, the tin mineralization was controlled by granite and intensity of geological structures which was spreaded out the each block. The type of mineralization consists of greisen, vein and skarn.
		Reliable geological maps and cross sections should exist to support interpretations.	The geological data were in the form of local geological map, geological model and its section. Supporting data such as geophysical and geochemical data was also provided for each block area
16	Data aggregation methods.	In reporting Exploration Results, weighting averaging techniques, maximum and/or minimum grade truncations (e.g. cutting of high grades) and cut-off grades are usually material and should be stated	The deposits on each block had taken into account the top and bottom cut of grade or the geological cut off by statistical methods. In this case the outlier was also considered.
		Where aggregate intercepts incorporate short lengths of high-grade results and longer lengths of low grade results, the procedure used for such aggregation should be stated and some typical examples of such aggregations should be shown in detail.	It was performed data compositing process with 1 m length for interval of composite that was boundaried by ore domain.
		The assumptions used for any reporting of metal equivalent	Resources estimation referred to the historis of highest

No	Criteria	Explanation	Commentary
		values should be clearly stated	tin price , i.e, $33.200/ton with cut off grade ranging between 0.01% - 0.1%.
17	Relationship between mineralization widths and intercept lengths	These relationships are particularly important in the reporting of Exploration Results.	The thickness of primary tin deposit within the PT Timah Tbk's concession have a range between 2-60 m.
		If the geometry of the mineralization with respect to the drill hole angle is known, its nature should be reported	
		If it is not known and only the down-hole lengths are reported, there should be a clear statement to this effect (e.g. „downhole length, true width not known").	
18	Diagrams	Where possible, maps and sections (with scales) and tabulations of intercepts should be included for any material discovery being reported if such diagrams significantly clarify the report	The maps, section and bore list were provided on the report content
19	Balanced reporting	Where comprehensive reporting of all Exploration Results is not practicable, representative reporting of both low and high grades and/or widths should be practiced to avoid misleading reporting of Exploration Results.	Reporting Exploration Results was entirely performed as is exposed on the report content.
20	Other substantive exploration data.	Other exploration data, if meaningful and material, should be reported including (but not limited to): geological observations; geophysical survey results; geochemical survey results; bulk samples – size and method of treatment; metallurgical test results; bulk density, groundwater, geotechnical and rock characteristics; potential deleterious or contaminating substances.	All substantial exploration data had been included within the report content.
21	Further work.	The nature and scale of planned further work (e.g. tests for lateral extensions or depth extensions or large-scale step-out	The next planned works were allocating the infill drilling, sampling on the block that still had low

No	Criteria	Explanation	Commentary
		drilling).	confident level and some location needed to run a metallurgical test work.
Estimation and Reporting of Mineral Reserves (Criteria listed in the first group, and where relevant in other preceding groups, apply also to this group)			
22	Database integrity.	Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes	The Competent Person had validated the database to ensure the coherence between collar, assay, survey and geo data.
		Data validation procedures used.	To match between collars, assays, surveys and geo data by checking if there are any data duplication, missing intervals, and the empty interval lengths. It used software from the micromine 2020 to check all the data
23	Site visit	CPI must include a Commentary on the results of the field visit.	Site visit had been performed with the result that resources estimation could be followed up.
		Jika kunjungan lapangan tidak dilakukan, jelaskan alasannya.	Site visit had been done
24	Geological Interpretation.	Confidence in (or conversely, the uncertainty of) the geological interpretation of the mineral deposit.	The confidence of ore interpolation was relied on the density of drill holes, correlation of ore continuity and grade continuity. They all were based on variogram analysis
		Nature of the data used and of any assumptions made.	On geological interpolation process, it needed the understanding of ore body which are performed with lithology data, alteration, mineralization, grade analysis and other related data also did a kind of geostatiscal analysi
		The effect, if any, of alternative interpretations on Mineral Resource estimation	No alternative interpretation was provided
		The use of geology in guiding and controlling Mineral Resource estimation	The lithology, alteration and mineralization was applied as a controller for grade basis domain determining.
		The factors affecting continuity both of grade and geology.	The factor that affected grade and geology continuity were distribution of structure in each block and the differences of geological domain.
25	Dimensions	The extent and variability of the Mineral Resource expressed	The thickness and the length of the ore body in each

No	Criteria	Explanation	Commentary
		as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource	block are varied that depend on a type of deposits. The explanation regarding this thing was listed on the report content.
26	Estimation and modelling techniques	The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domain, interpolation parameters, maximum distance of extrapolation from data points.	The capping grade process on extreme value was adjusted with the statistical result. The domaining process was created by considering the characteristic of ore body. Maximum extrapolation distance from data point was as far as a half of drillholes spacing.
		The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data	The estimation considered mining activity that had been done on the several blocks.
		The assumptions made regarding recovery of by-products	No estimation was performed for by-product
		Estimation of deleterious elements or other non-grade variables of economic significance (e.g. sulphur for acid mine drainage characterization).	There was no impurities element that was impacted to the mining economics
		In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed.	The applied block size was varieted for each block. It depended on drillhole density on that block, grade variety on each drillhole, dimensions and direction of ore body. The searching radius was 2/3 of range for measured resources, 1 of range for indicated resources and > 1 of range for inferred resources (Snowden, 2011). The grade that was applied to estimation should be above for the Cut off garde (COG).
		Any assumptions behind modelling of selective mining units	There was no assumption for the selective mining unit (SMU)
		Any assumptions about correlation between variables	The apllied assumption for correlation between the variables was different for each resources class. The measured resources had total of 11 samples minimum, 5 sample for each sector maximum, 2 drill hole with 2/3 of range minimum. The indicated resources had total of 11 samples minimum, 5 sample for each sector maximum, 2 drill hole with 1 of range minimum. Inferred resources had total of 1 samples minimum, 5

No	Criteria	Explanation	Commentary
			sample for each sector maximum, 1 drill hole with > 1 of range minimum.
		The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available	The model of validation and estimation was held with comparing between true grade versus estimated grade by using the scattergraph.
		Detailed description of the method used and the assumptions made to estimate tonnages and grades (section, polygon, inverse distance, geostatistical, or other method	The statistical and geostatistical method was applied to the estimation process. Data interpolation was held by the method of ordinary krigging
		Description of how the geological interpretation was used to control the resource estimates.	It was held the domaining process for mineralization zone as a controller of resources estimation.
		Discussion of basis for using or not using grade cutting or capping. If a computer method was chosen, description of programmes and parameters used.	The capping grade process was based on statistical result that used software Micromine 2020.
		Geostatistical methods are extremely varied and should be described in detail. The method chosen should be justified. The geostatistical parameters, including the variogram, and their compatibility with the geological interpretation should be discussed. Experience gained in applying geostatistics to similar deposits should be taken into account	The applied geostatiscal method was ordinary kriging method that interpolation parameters was created from variogram. The model that created from variogram was validated to see the accuracy. The validation was performed by comparing between original data versus estimated data. The model of primary tin deposit within the estimated block generaly had a similarity with the other model of primery tin deposit.
27	Moisture	Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content	The tonnage was estimated in dry condition
28	Cut-off parameters.	The basis of the adopted cut-off grade(s) or quality parameters applied.	The applied cut off was used after considering economical aspect. The used assumption of the tin metal price for the resources estimation referred to the historical of highest tin metal price, i.e $33.200/ton
29	Mining factors or assumptions.	Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It may not always be possible to make assumptions regarding mining methods and parameters when estimating Mineral Resources. Where no assumptions	The assumption for mining method was applicating the open pit method with including mining cost parameter, mining recovery, mining dilution, tin price forecasting, royalty and overall slope

No	Criteria	Explanation	Commentary
		have been made, this should be reported	
		In order to demonstrate realistic prospects for eventual economic extraction, basic assumptions are necessary. Examples include access issues (shafts, declines, etc.), geotechnical parameters (pit slopes, stope dimensions etc.), infrastructure,requirements and estimated mining costs. All assumptions should be clearly stated	
30	Metallurgical factors or assumptions	The basis for assumptions or predictions regarding metallurgical amenability. It may not always be possible to make assumptions regarding metallurgical treatment processes and parameters when reporting Mineral Resources. Where no assumptions have been made, this should be reported	The estimated ore was extractable metalurgically
31	Bulk Density	Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples	The bulk density measurement used the water displacement method and in the bulk way. The applied equipment was weigher that able to measure the sample on dry conditions and when the sample was sunken within the water. The bulk density was held for 5 m sample intervals with similar lithology. While if there was variated within the 5 m interval, then it was required to held several measurements that represent each of the differences of lithology.
32	Classification.	The basis for the classification of the Mineral Resources into varying confidence categories	The applied estimation of resources was relied on the searching radius parameter, grade interpolation, drillhole density, minimum number of sample and of drilhole
		Whether appropriate account has been taken of all relevant factors. i.e. relative confidence in tonnage/grade computations, confidence in continuity of geology and metal values, quality, quantity and distribution of the data	The data validation displayed well correlation between assay data with estimated data.
		Whether the result appropriately reflects the CPI‟s view of the deposit	The resources estimation had been discussed, modified, and approved by competent person.

No	Criteria	Explanation	Commentary
33	Audits or reviews.	The results of any audits or reviews of Mineral Resource estimates.	The audit and review was held internally. The application of statistical and geostatistical procedure was used to estimate the resources and examine the confidence level of data. All those things was reflected on the resources report.
34	Discussion of relative accuracy/confidence.	Where appropriate a statement of the relative accuracy and/or confidence in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person Indonesia. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate	The cross validation method was performed to increase the confidence level for the Competent Person until > 95%.
		The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages or volumes, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used	The reported resources statement for each block was adjusted with the constraint of cut off.
		These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.	The production data had not been applicated yet as a comparator for the resources estimation
Estimation and Reporting of Mineral Reserves (Criteria listed in the first group, and where relevant in other preceding groups, apply also to this group)			
35	Mineral Resource estimate for conversion to Mineral Reserves.	Description of the Mineral Resource estimate used as a basis for the conversion to a Mineral Reserve	Only the indicated and measured resources was able to convert as the mineral reserves
		Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Mineral Reserves	The reported mineral reserves was a part of the resources
36	Site visit	CPI must include a Commentary on the results of the field visit	The Competen Person had performed site visit to the areas of PT Timah Tbk's reserves block . Those blocks

No	Criteria	Explanation	Commentary
			were Pemali, Batubesi and Tempilang..
		In condition where a field visit is not performed then give the excuse	The site visit had been performed
37	Study status.	The type and level of study undertaken to enable Mineral Resources to be converted to Mineral Reserves.	In case of converting the resources to reserves, the Competent Person of PT Timah Tbk had made some studies that related with pre feasibility study and feasibility study for each reported primary block as the reserves.
		The Code does not require that a final feasibility study has been undertaken to convert Mineral Resources to Mineral Reserves, but it does require that at least Pre-Feasibility level will have determined a mine plan that is technically achievable and economically viable, and that all Modifying Factors have been considered	
38	Cut-off parameters.	The basis of the cut-off grade(s) or quality parameters applied.	The cut-off grade was estimated with the cash flow method against the income and costs that will occur later. The software of Micromine 2020 was operated as a supporting tool
39	Mining factors or assumptions.	The method and assumptions used to convert the Mineral Resource to a Mineral Reserve (i.e. either by application of appropriate factors by optimization or by preliminary or detailed design).	The mining method was planned by using truck-excavator configuration. Processing minerals was applied gravity properties with wet base processing equipment
		The choice of, the nature and the appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc	The pit optimasation on the software of Micromine 2020 was operated to define the economical pit boundary which were relied on these value : • Mining recovery assumption 95% • Mining dilution assumption 5% • Mining processing recovery 80% • Smelting recovery assumption 99.4% • Royalty 3%
		The assumptions made regarding geotechnical parameters (e.g. pit slopes, stope sizes, etc.), grade control and pre-production drilling	
		The major assumptions made and Mineral Resource model used for pit optimization (if appropriate)	
		The mining dilution factors, mining recovery factors, and minimum mining widths used	
		The infrastructure requirements of the selected mining methods.	
40	Metallurgical factors	The metallurgical process proposed and the appropriateness	The recovery of mineral processing was 98,57%. It was

No	Criteria	Explanation	Commentary
	or	of that process to the style of mineralization	relied on the actual data of Tin Ore Mineral Processing Center (PPBT) on period of 2013-2019.
		Whether the metallurgical process is well-tested technology or novel in nature.	
		The nature, amount and representativeness of metallurgical test work undertaken and the metallurgical recovery factors applied	
		Any assumptions or allowances made for deleterious elements.	
		The existence of any bulk sample or pilot scale test work and the degree to which such samples are representative of the orebody as a whole.	
41	Cost and revenue factors.	The derivation of, or assumptions made, regarding projected capital and operating costs.	The applied capital cost was based on infrastructure, mining equipment, and the used processing equipment on each mining site. The revenue calculation was based on the dilution of reserves grade and the assumption of tin metal price at $17.200/ton
		The assumptions made regarding revenue including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, etc.	
		The allowances made for royalties payable, both Government and private	
42	Market assessment.	The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future.	PT Timah Tbk's tin metals were basically international commodities which the weight quantity, Sn content and the impurity had met with London Metal Exhange's regulation PT Timah Tbk sold tin metal products to the big scale customers. Meanwhile PT Timah Tbk empowered its subsidiary which was domiciled at UK for small scale customers. PT Timah Tbk also operated marketing strategies by selling the downstream products and solder. The sold downstream product was in the form of tin alloy and tin chemical.
		A customer and competitor analysis along with the identification of likely market windows for the product	
		Price and volume forecasts and the basis for these forecasts	
		For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.	
43	Other.	The effect, if any, of natural risk, infrastructure, environmental, legal, marketing, social or governmental	PT Timah Tbk stated that the status of agreement with government and substantial approval for project

No	Criteria	Explanation	Commentary
		factors on the likely viability of a project and/or on the estimation and classification of the Mineral Reserves	continuity such as concession status was entirely in good performance.
		The status of titles and approvals critical to the viability of the project, such as mining leases, discharge permits, government and statutory approvals.	By enactment of Regulation of the Minister of Trade of the Republic of Indonesia Number 32 of 2013 was concerning Tin Export Provision that obliged one-door policy for the exporting of tin metal. The door should went through the Indonesia Commodity & Derivatives Exchange (ICDX or BKDI). Therefore PT Timah Tbk asked all their big scale customers to join as the member of ICDX in order to get directly access for tin metal product.
44	Classifications	The basis for the classification of the Mineral Reserves into varying confidence categories.	Mineral Reserves Estimation was referred to Mineral Resources Estimation that been classified as "Indicated" or "Measured" all totally after considered all aspect of mining, metallurgy, social, environment and finance. The proven mineral reserves was converted from measured resources. Meanwhile the probable mineral reserves was converted from indicated resources.
		Whether the result appropriately reflects the CPI"s view of the deposit.	
		The proportion of Probable Mineral Reserves, which have been derived from Measured Mineral Resources (if any).	
45	Audits or reviews.	The results of any audits or reviews of Mineral Reserve estimates	Additional review or audit is still undergoing
46	Discussion of relative accuracy/confidence	Where appropriate a statement of the relative accuracy and/or confidence in the Mineral Reserve estimate using an approach or procedure deemed appropriate by the Competent Person Indonesia. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate	Confidence relativity for reserves estimation was reflected within the reserves report for proven and probable category as per KCMI 20217 code. Report making for reserves was held by internal team of PT Timah Tbk which was controlled and supervised by Competent Persons so that the independency was well maintained
		The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages or volumes, which should be relevant to technical and economic	The reserves was reported either globally or for each concession. The result of detailed reserves estimation was provided in locally scale as an addition for entire of

No	Criteria	Explanation	Commentary
		evaluation. Documentation should include assumptions made and the procedures used.	project
		These statements of relative accuracy and confidence of the estimate should be compared with production data, where available	The operation of PT Timah Tbk had taken place for a long time that included exploration activity, mining, production and marketing. All the aspects have been considered for reserves estimation process.

APPENDIX D — 2019 GRASBERG RESERVES STATEMENT

PT Freeport Indonesia (PTFI)

Mineral Resources and Ore Reserves Statement

31 December 2019

KCMI - 2017

1. Introduction

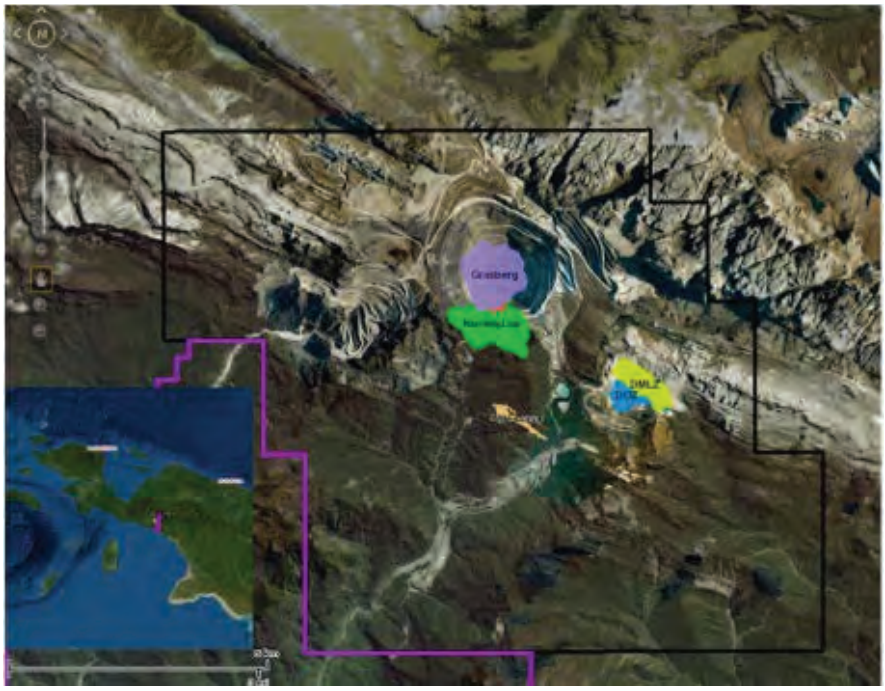
PTFI Mineral Resource and Ore Reserves are reported 31 December 2019. The assessment is based on diamond drilling core data collected to mid-June 2019. The Mineral Resource and Ore Reserve estimate are reported in accordance with the guidelines in the Komite Cadangan Mineral Indonesia (KCMI) – 2017. Reported Mineral Resources and Ore Reserves are compiled by Competent Persons (as defined by 2017 KCMI Code). The Competent Person statement and the KCMI Table 1 are provided in Appendix 1. This Statement sets out all relevant information concerning PTFI Mineral Resource and Ore Reserves in accordance with the 2017 KCMI Code.

After mining out by the end of 2019 the final phase of Grasberg Open Pit, the Grasberg mineral district includes the following underground mines that are being operated or in advanced development: Grasberg Block Cave, the Deep Mill Level Zone (DMLZ), Big Gossan and the Deep Ore Zone (DOZ). PTFI is ramping up production from GBC and DMLZ underground mines and is achieving important milestones to produce large-scale quantities of copper and gold.

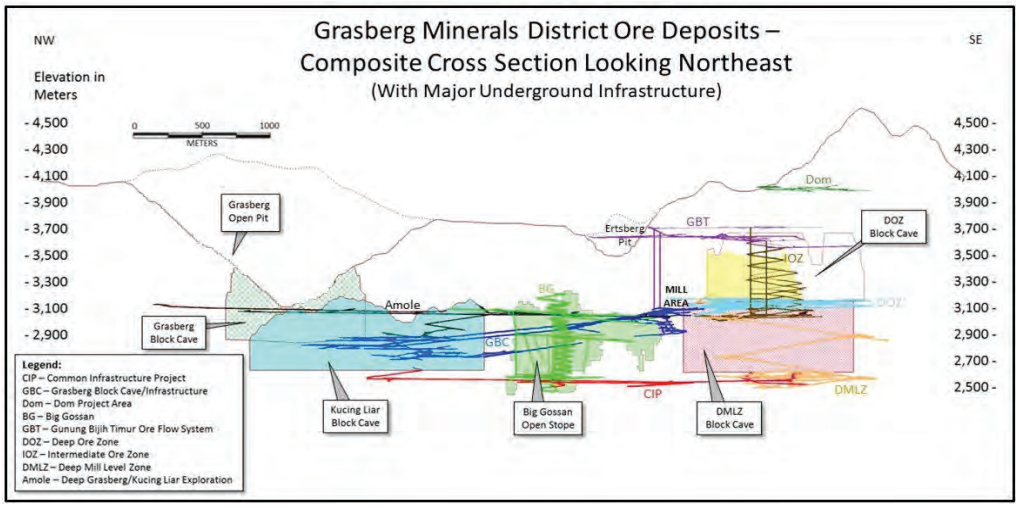
Production from the Grasberg minerals district totaled 0.6 billion pounds of copper and 0.9 million ounces of gold in 2019, 1.2 billion pounds of copper and 2.7 million ounces of gold in 2018, and 1.0 billion pounds of copper and 1.6 million ounces of gold in 2017.

2. Project Location

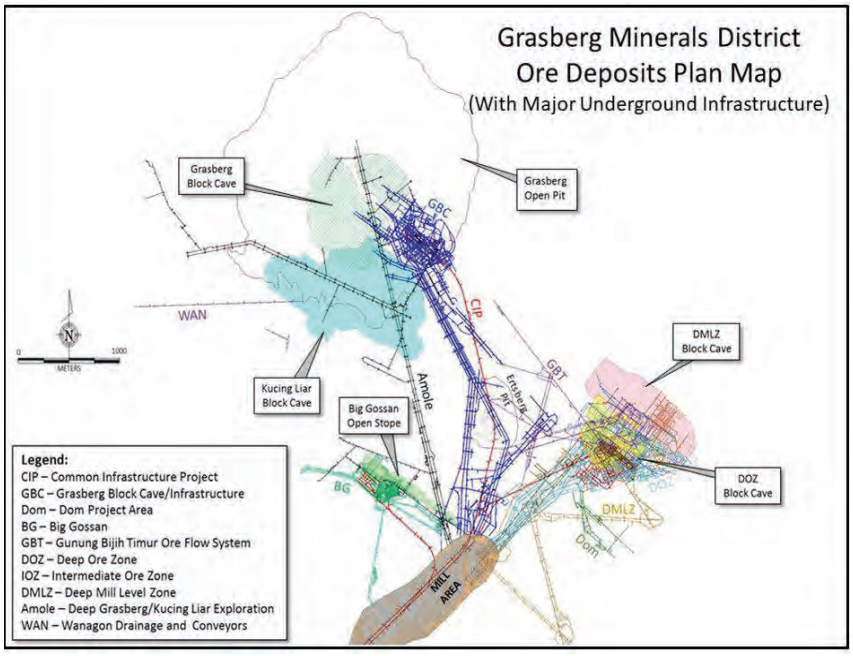
PT-FI operates in the remote highlands of the Sudirman Mountain Range in the province of Papua, Indonesia, which is on the western half of the island of New Guinea. Since 1967, PT-FI and our predecessors have been the only operator of exploration and mining activities in the approximately 10,000 hectare operating area. (Regional).



The following diagram indicates the relative elevations (in meters) of our reported PTFI ore bodies.



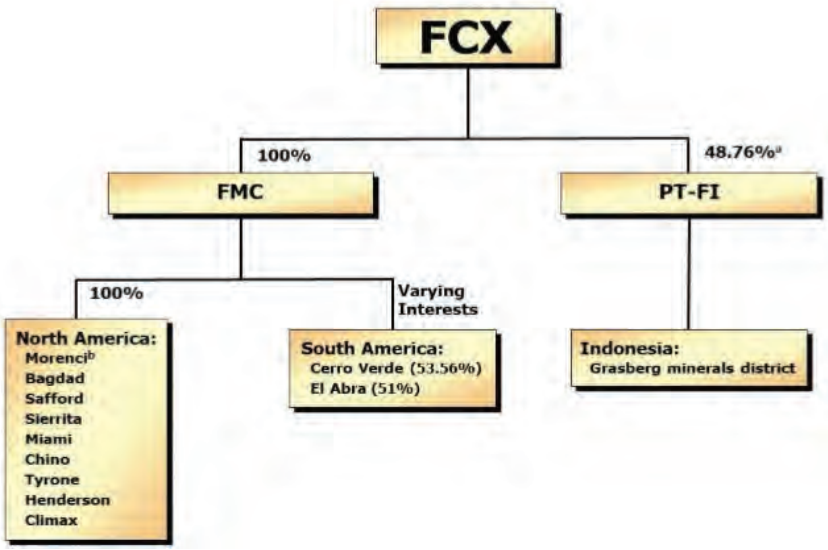
The following map, which encompasses an area of 42 square kilometers, indicates the relative positions and sizes of our reported Indonesia ore bodies and their locations.



3. Project Tenure, Ownership and Management

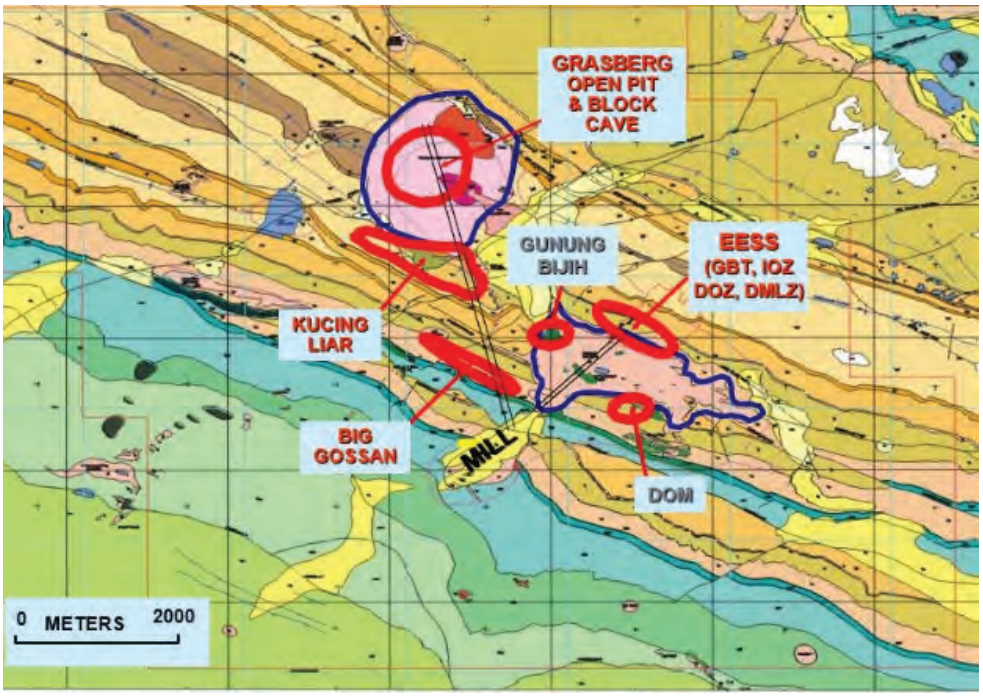
PT-FI is a limited liability company organized under the laws of the Republic of Indonesia. On December 21, 2018, Freeport-McMoRan (FCX) completed the transaction with the Indonesian government regarding PT-FI's long-term mining rights and share ownership. Following the transaction, FCX has a 48.76 percent share ownership in PT-FI and the remaining 51.24 percent share ownership is collectively held by PT Indonesia Asahan Aluminum (Persero) (PT Inalum), an Indonesian state-owned enterprise, and PT Indonesia Papua Metal Dan Mineral (PTI – formerly known as PT Indocopper Investama), which is expected to be owned by PT Inalum and the provincial/regional government in Papua, Indonesia. The arrangements related to the transaction also provide for FCX and the other pre-transaction PT-FI shareholders to retain the economics of the revenue and cost sharing arrangements under the former Rio Tinto Joint Venture. As a result, FCX economic interest in PT-FI is expectedto approximate 81 percent through 2022.

The Indonesian government granted PT-FI an IUPK to replace its former COW, enabling PT-FI to conduct operations in the Grasberg minerals district through 2041. Under the terms of the IUPK, PT- FI has been granted an extension of mining rights through 2031, with rights to extend mining rights through 2041, subject to PT-FI completing the construction of a new smelter in Indonesia within five years of closing the transaction and fulfilling its defined fiscal obligations to the Indonesian government. The IUPK, and related documentation, contains legal and fiscal terms and is legally enforceable through 2041.
The following diagram indicates the Ownership of PTFI:



4. Geological Description

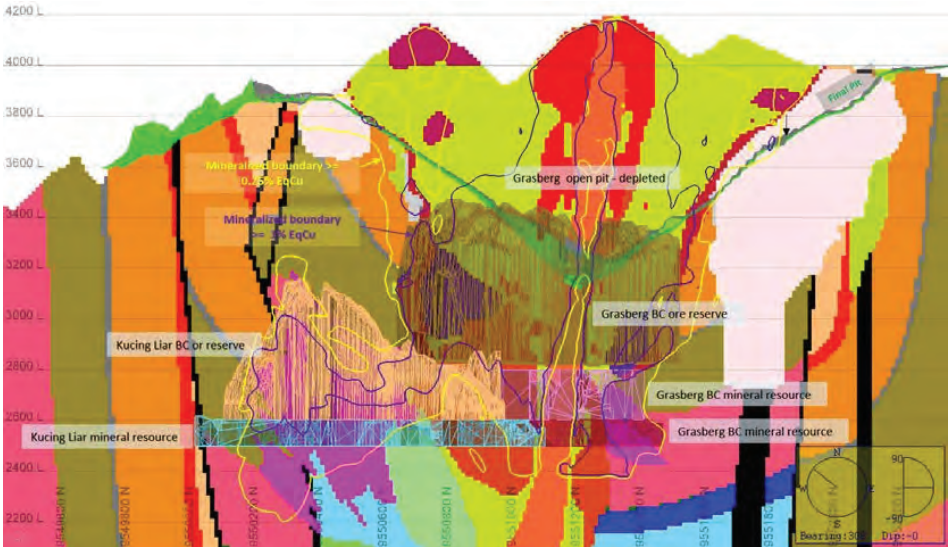
The ore bodies are located within and around two main igneous intrusions, the Grasberg monzodiorite and the Ertsberg diorite. The host rocks of these ore bodies include both carbonate and clastic rocks that form the ridge crests and upper flanks of the Sudirman Range, and the igneous rocks of monzonitic to dioritic composition that intrude them.



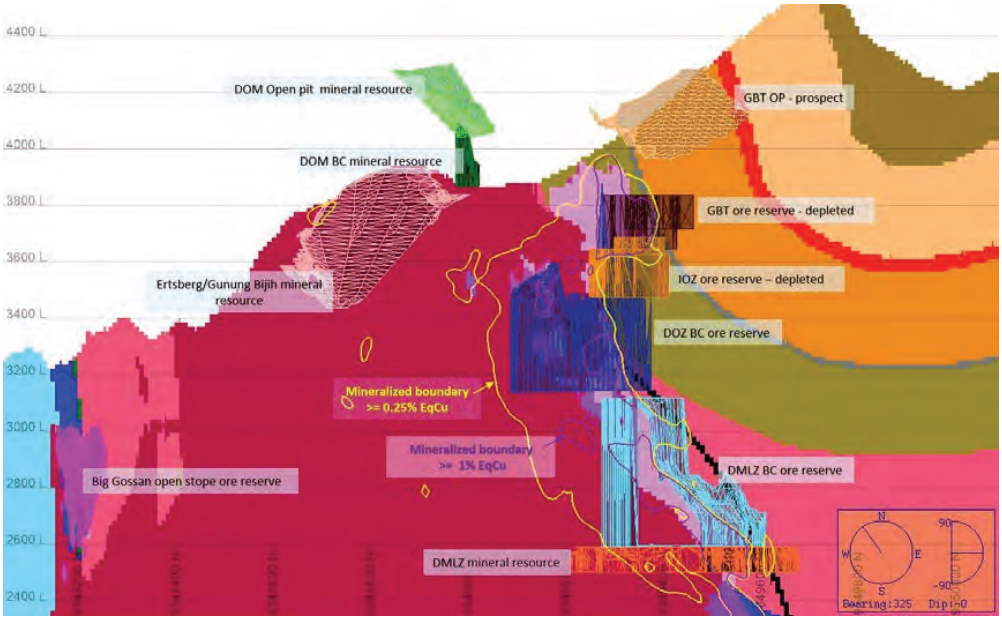
5. Alteration and Mineralization

The igneous-hosted ore bodies (the Grasberg Block Cave, and portions of the DOZ) occur as vein stockworks and disseminations of copper sulfides, dominated by chalcopyrite, and to a lesser extent, bornite. The sedimentary-rock hosted ore bodies (portions of the DOZ and all of the Big Gossan) occur as "magnetite-rich, calcium/magnesian skarn" replacements, whose location and orientation are strongly influenced by major faults and by the chemistry of the carbonate rocks along the margins of the intrusions. The copper mineralization in these skarn deposits is dominated by chalcopyrite, but higher bornite concentrations are common. Moreover, gold occurs in significant concentrations in all of the district's ore bodies, though rarely visible to the naked eye. These gold concentrations usually occur as inclusions within the copper sulfide minerals, though, in some deposits, these concentrations may be strongly associated with pyrite.

Cross section bellow shows the geology map and mineralization zones perpendicular to the ore bodies of Grasberg mineralization district.



And cross section bellow shows the geology map and mineralization zones perpendicular to the ore bodies of Ertsberg mineralization district.



6. Data and Data Collection Method

6.1. Data Location

PTFI geology database uses acQuire SQL database system. Data is logged directly into the database utilizing wireless transfer protocols on portable computers. Validation checks are written into the SQL Server database and these are activated via database and user triggers to ensure the data is correct with respect to fundamental quality issues. Project geologists review data entered into acQuire, both assay and geo-log data. Resource estimation procedure evaluates the highest grade analysis in each estimation domain to validate proper data entry. Analysis from the laboratories are electronically transferred. Read/write privileges of the primary tables in the database are controlled through the use of security group permissions. Individual user profiles restrict the data that can be accessed and altered. The database has a log backup each hour by our IT department. A complete backup is completed each night.

6.2. Topography

Topographic control for the entire district is by LIDAR which provides a high quality and accurate model of the topographic surface. The UTM (WGS84) coordinate system is used to collect primary location data.

6.3. Drill Data

Diamond drilling is the only drilling method used to derive samples for resource determination. Core size used is variable and dependent on the equipment available and the length and orientation of the drill hole. Collar casings are commonly set using PQ for surface and HQ for UG drilling is the preferred starting core diameter. Core diameter reduces down-hole as required by equipment capability or ground condition.

Core orienting and Televiewer have been carried out on selected holes through the history of the project. The methods used represent the range of techniques available to industry at the time, with no particular method considered a standard. Core orienting data has no effect on resource calculations, but can be used as a geotechnical input to pit or stope designs.

Core recovery is calculated using the ratio of 'length of core recovered' to 'length of drilled interval'. Optimization of core recovery is addressed through use of larger core diameters, mud programs, and drilling rates. Studies have shown no significant bias between core recovery and grade. These studies have shown that a strong correlation between accuracy and core recovery. Based on these studies, we allow the use of assay data for core recoveries as low as 30%.

All drill core undergoes detailed geological, mineralogical, and geotechnical logging to high industry standards. All logging information is stored digitally and is available as input to resource modelling and reserve determination processes. Mineralogy logging is quantitative and supported by XRD analysis, 3m sample for XRD analysis is collected on a 50m spacing in the deposit areas. Geotechnical logging follows standard RQD and RMR methods.

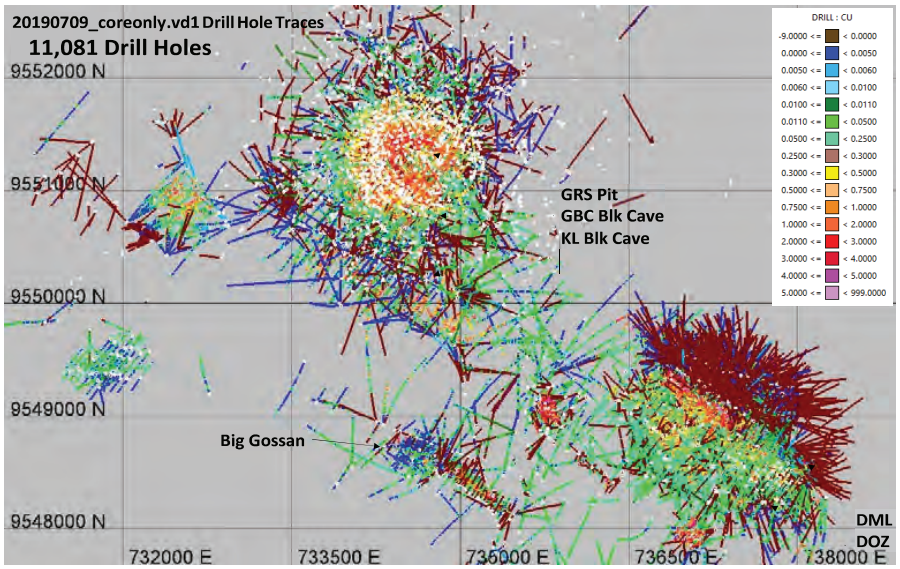
All drill core is photographed in core trays prior to splitting. Core photographs are cataloged and stored digitally. Logging is carried out on the complete drill hole.

Table below shows number of holes, total meters drilled and assay statistics as of end of June 2019.

IUPK Project	Number of holes	Total meters
PTFI	11,081	3,199,172

Metal	Mean	Min	Max	STD	CV
Cu%	0.69	0.00	59.49	1.21	1.76
Au_ppm	0.59	0.00	1,459.07	2.32	3.92
Ag_ppm	4.01	0.10	1,880.00	11.36	2.83

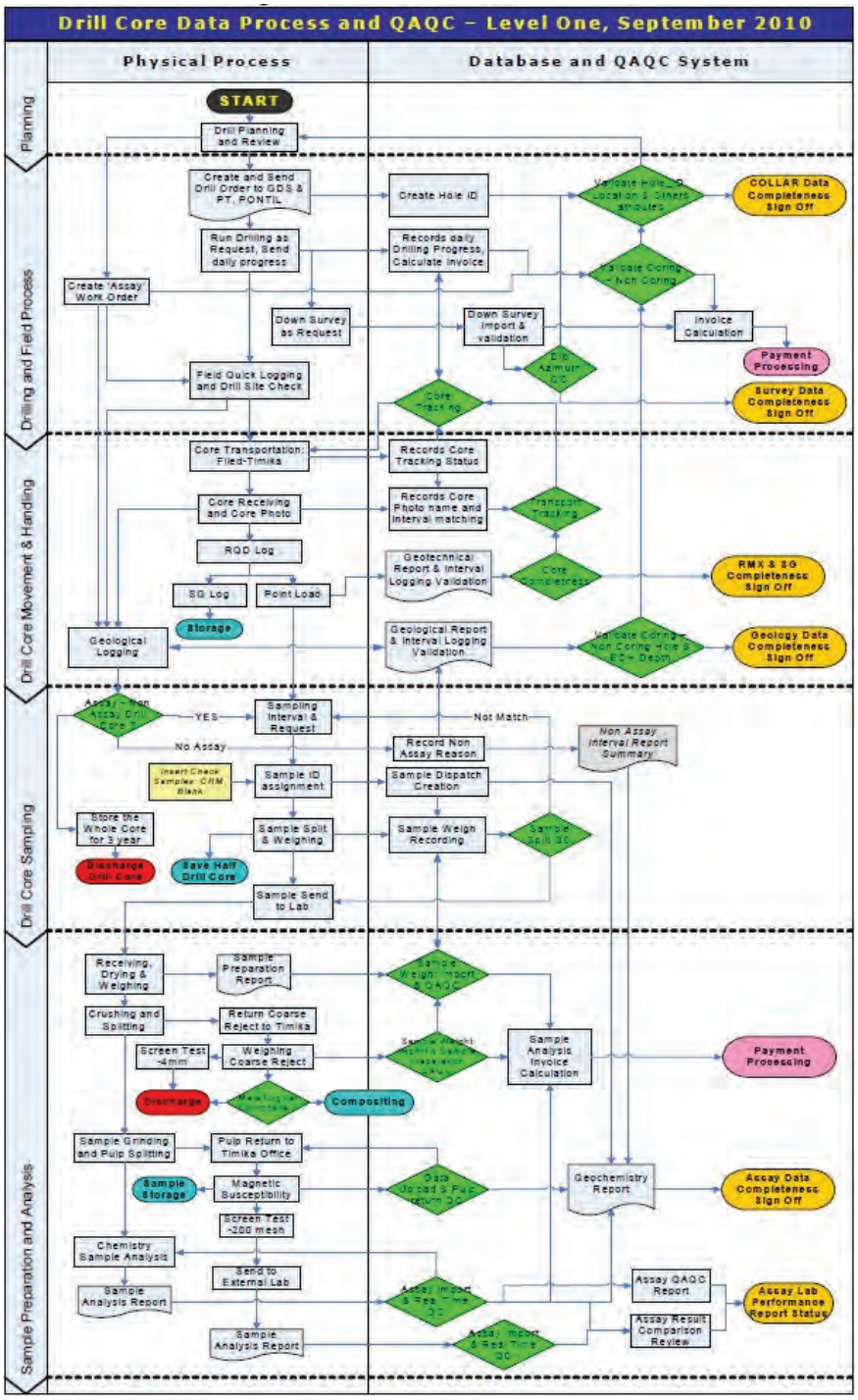
Map bellow showing all diamond drill hole traces with Copper grades.



6.4. Drill Core

All exploration and drilling and dewatering drilling used for model assembly. Exploration and dewatering drilling used for modeling has been by wire line diamond core methods. Current drilling is generally HQ diameter and may reduce to NQ for extended depth holes. The entire data base at PTFI consists of a mix of drill core sizes from HQ to BQ. Earlier drill programs often collared NQ holes and reduced to BQ for deep drilling. Most of the material estimated with BQ diameter drilling has been mined out by this time. The drill core is boxed at the rig in plastic boxes, transported from the drill sites to the core handling and marshaling facility called Kasuang at Mile 74. Core is collected at Kasuang and loaded into small secured transport containers. Documentation is prepared for the transport to Timika and the containers are delivered to Timika by a dedicated core transport truck. The core tracking system is contained within the acQuire data base system and constitutes a thorough check list and reporting program to track the sample location and progress through transport, preparation, assay, and incorporation into the data base.

The treatment of the diamond core data as currently practiced at PTFI is summarized in this following Table:



6.5. Bulk Density

Dry bulk density (SG) was determined by following process:

- A piece of core from each sampled value is weighed in air and weighed againsuspended in water providing a Bulk or SG for that piece of core. SG from core not sampled is also measured every three meters and added to the database with the sampled intervals. Weight in air/(weight in air–weight in water) = SG.
- A sample bias (BulkF) occurs because weighing crushed or highly alteredrock is difficult so the sampler chooses solid rocks to weigh. A factor applied to the bulk measurement compensates for sample bias. The factor considers RQD, broken and crushed measurements.

  BulkF = RQD + (0.923 x Broken) + (0.864 x Crushed) Crushed = fraction of run < 1.0 cm pieces
  Broken = fraction of run in pieces between 1.0 cm and RQD length
  RQD = fraction of run > 2 core diameters (usually 10cm)
- A default value for each estimation zone is applied based upon the mean, median and correlation coefficient for each zone.

Bulk measured every three meters of drill core and composited into 15m for resource estimation. Bulk is capped at the assay level with minimum value of 1.8 and a maximum value of 5.5 SG. BulkF is capped at the assay level with a minimum value of 0.85 and a maximum value of 0.985.

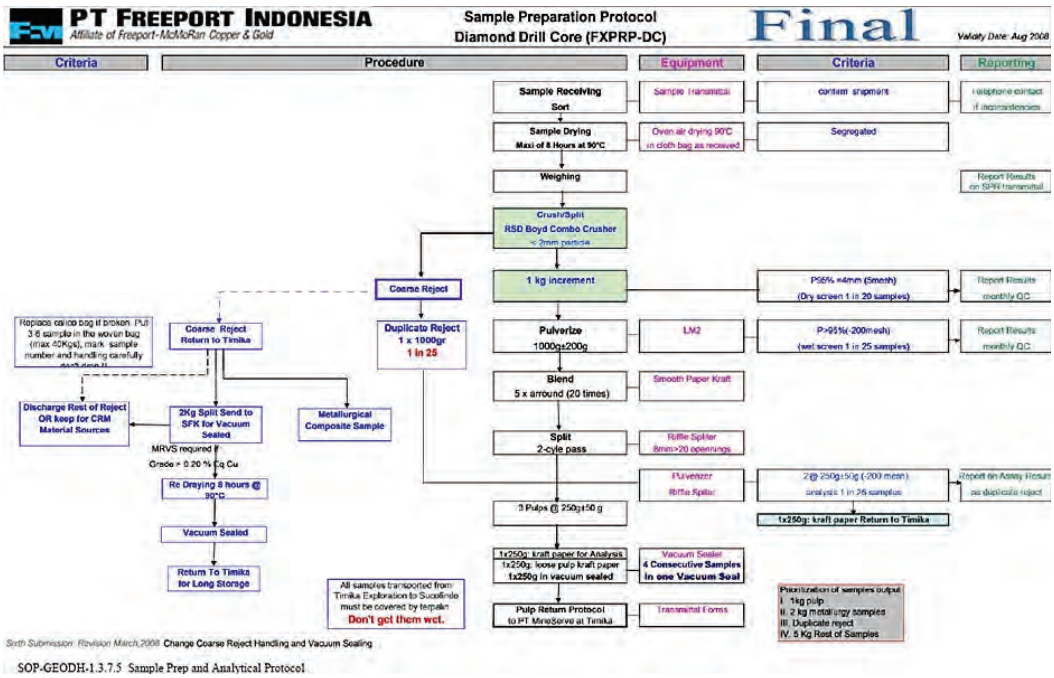
6.6. Chemical Assay Analysis

6.6.1 Sampling and Preparation Method

Drill core is split longitudinally using either an impact splitter or diamond sawing. The former method is by far the most common method used in the programs. Half the split core is replaced into the original core tray. The other half of the split core is placed in a cloth bag, labeled with a sample number, and submitted to a laboratory for preparation and analysis. Where taken, continuous chip (channel) samples are processed in total. The entire sample is placed in a cloth bag, labeled with a sample number, and submitted to a laboratory for preparation and analysis. Assay instructions are supplied to Sucofindo electronically by Timika core shed personnel. The project geologist has three options: full assay, no assay, or selected assay. No assay can be used where assay information already exists, as in dewatering holes for example. The option of selective assay can be flexible. If the rock type is observed to be barren or a portion of the hole extends away from existing assay data the geologist can reduce assays as a cost savings.

Each pulp is analyzed for the reserve elements, and possibly for other attributes. Cu, and Ag are determined using 2, 3, or 4 acid digestion, depending on the capabilities of the lab, chemistry of the ore, or other factors, and then analyzed by AAS or ICP methods. Au is determined by fire assay using a 15, 20, 30, or 50-gram charge, depending on the sample matrix and coarseness of the gold. Final determination uses either AAS or Gravimetric finish, depending on the capabilities of the lab and the concentration of Au in the sample. The analytical techniques applied are all industry standard for the types of ores being tested.

Diagram of Sample Preparation Protocol for Diamond Drill Core Samples at the Sucofindo lab.



6.6.2. Total Elements Analyzed

This section will focus on the assays for Cu, Au and Ag that are used directly in the reserve grade calculations. All assays for diamond core are assayed at the Sucofindo Laboratory in Timika where the CCLAS system, a commercially available Laboratory Information Management System, is in use to control, store, and transfer analytical results are electronically.

6.7. Quality Assurance and Quality Control

QA/QC programs for analytical testing are in place for all projects and laboratories. These programs for standard protocols, are evaluated regularly, and provide short-term feedback to the project owners and the analytical laboratory. Laboratory QC is accomplished using intralab replicates, interlab duplicates, and a standards program. Standards and duplicates are inserted into all sample batches.

6.8. Geotechnical Analysis

Ordinary Kriging (OK) used to estimate the RQD in annual basis. A 3m run length compositing routine in Vulcan was run on the core-only diamond drill hole database to create the RQD estimation database. The RQD model should be treated cautiously and should only be used to indicate bulk rock mass characteristics. Smoothing of the RQD values still occurs by using several values to estimate a block, and the variance reduction inherent in scaling up from 3m composites to 15m3 blocks still exists. The coarse nature of the 15m3 model does not allow small-scale structural features to be accurately represented.

The point load strength (pld_is50mpa) model updated in annual basis. In addition to the primary point load model, which uses only point load failure types of Intact (I) and Multiple (M), a second point load estimation run was performed using all failure types, including Both(B) and Structure (S). This variable is stored in the block model as pld_is50mpa_all. Additional estimates were made in 2019; one using only the (B) and (S) data (pld_is50mpa_bs), and an indicator estimate for whether the failure type is (I) or (M), or whether it is (B) or (S). The indicator estimate value is available in the block model variable pld_im_ind.

7. Data Evaluation

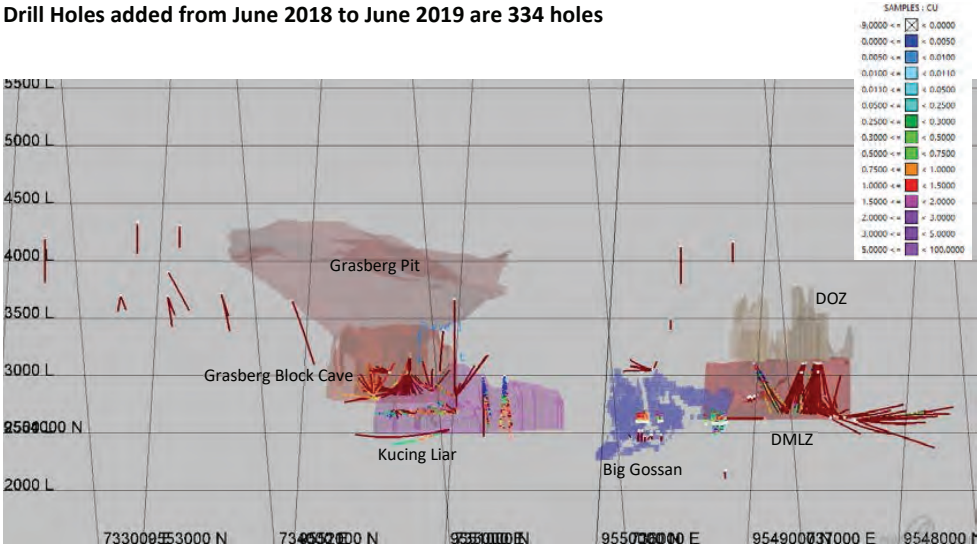
A CoWA 15m diamond drill hole composite database was provided from Geological Data Services at jobsite on 3 June, 2019 (amall_15_entry.csv). The composites were calculated using Techbase software.

A thorough check was completed on the raw assay and composite databases to ensure their integrity. All assay values that changed from the previous year were identified and database personnel provided explanatory notes for each change. All QA/QC results (blanks, standards, duplicates) were reviewed and deemed appropriate for acceptance of new assay results reported throughout the year.

7.1. Grasberg – Kucing Liar (GRSKL)

There are 334 additional holes added in 2019 as compared to 2018 with a total depth of 95,058 meters used in GRSKL model. The figure below shows drill traces of the added drill holes.

Drill Holes added from June 2018 to June 2019 are 334 holes

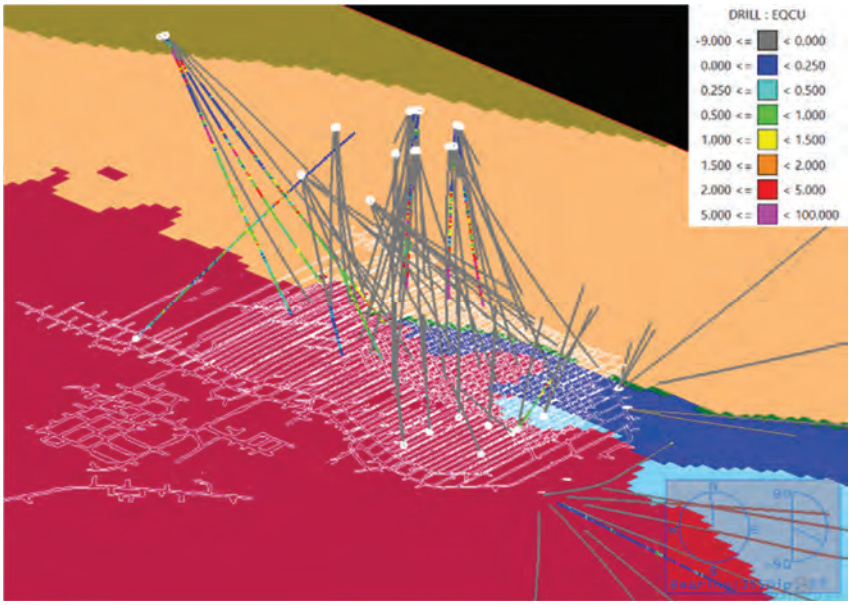


7.2. East Ertsberg Skarn System(EESS)

The database was flagged with the eess_mdl_lmt.00t in the BOUND field, exported and trimmed to contain the EESS samples. 116 new diamond drill holes were completed in the EESS model area since the 2018 EESS model release. These drill holes were completed for multiple purposes: 23 geotechnical monitoring holes, 66 hydro fracturing holes, and 27 dewatering holes to the

north and east of the DMLZ mine. Only a minor amount of new assays were acquired during the year, primarily from hydro fracture holes that filled gaps in the existing drilling network.

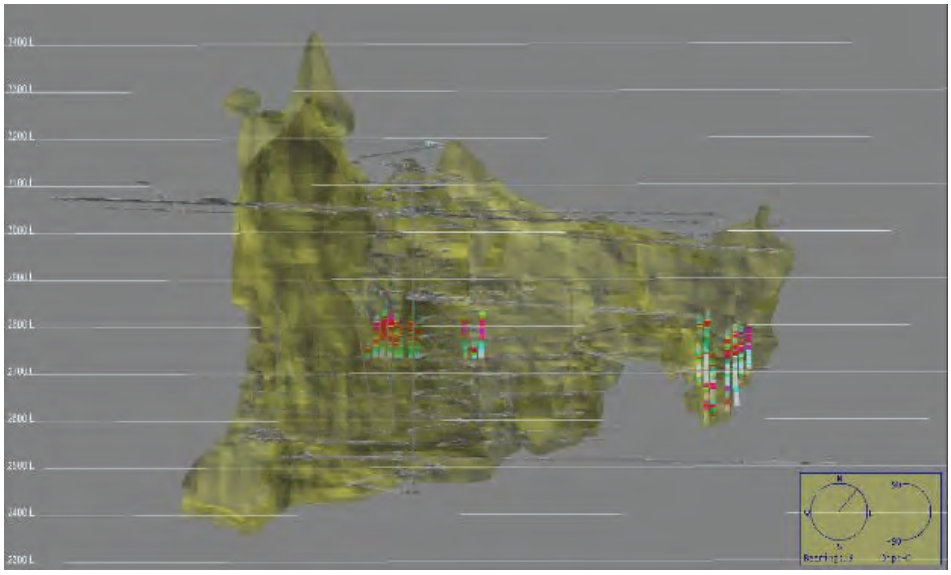
Figure bellow shows drill holes completed in the DMLZ area since the 2018 model update. Drill holes are colored by EqCu %. Grey hole traces indicate that these were not assayed – these holes were drilled for geotechnical monitoring and dewatering.



7.3. Big Gossan (BG)

Since the 2018 BG model release, 67 new diamond drill holes were completed in the Big Gossan resource model area. These drill holes were completed for various purposes. 46 were grade control holes on the 2720m and 2680m elevations, 9 were geotechnical holes, and 11 were hydrology holes. The new drilling added a total of 565 samples after compositing for estimation. Of these 565 samples, 147 were inside the new 2019 10k 1% EqCu ore shell.

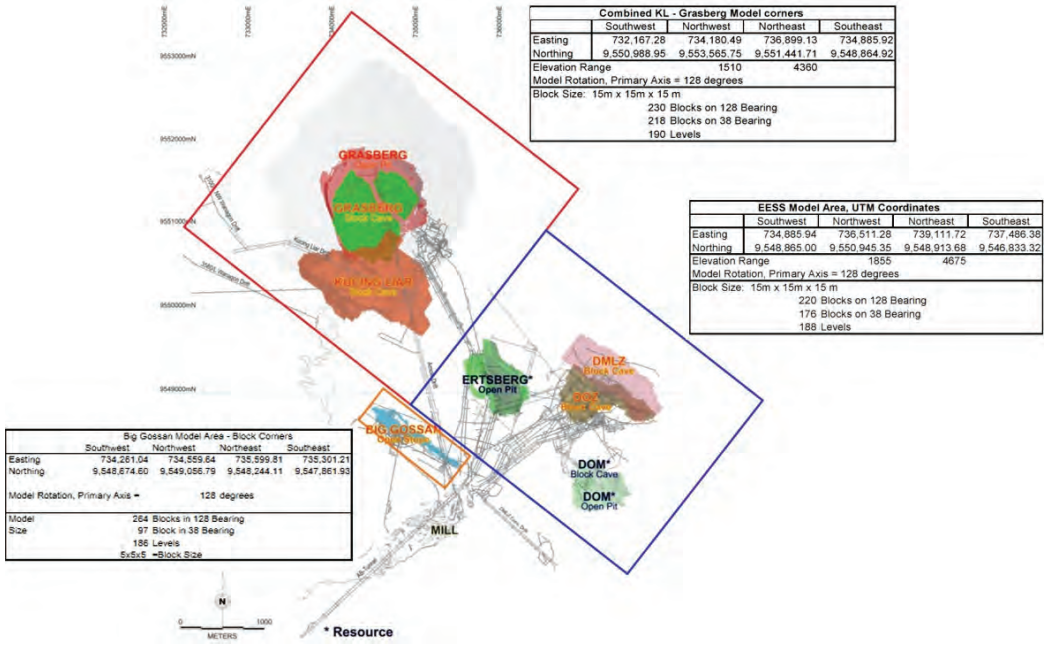
Below is a long section view to the northeast showing the new drilling in the Big Gossan between the data cutoff dates for the 2018 and 2019 models. The primary source of the new drilling is for grade control on the 2720m and 2680m levels. For reference the current Big Gossan mined surveys are shown semitransparent in grey alongside the semitransparent yellow for the 2019 10k 1% EqCu ore shell.



8. Modelling and Grade Estimation

Three resource block models provided and shows on the map bellow. The model updated in annual basis ever end of the year.

1) GRSKL (for GBC and KLBC deposits),
2) EESS (for DOZ, DMLZ, GBOP and DOM deposits),
3) BG (for Big Gossan deposit)



Combined KL - Grasberg Model corners				
	Southwest	Northwest	Northeast	Southeast
Easting	732,167.28	734,180.49	736,899.13	734,885.92
Northing	9,550,988.95	9,553,565.75	9,551,441.71	9,548,864.92
Elevation Range		1510	4360	
Model Rotation, Primary Axis = 128 degrees				
Block Size: 15m x 15m x 15 m				
230 Blocks on 128 Bearing				
218 Blocks on 38 Bearing				
190 Levels				

EESS Model Area, UTM Coordinates				
	Southwest	Northwest	Northeast	Southeast
Easting	734,885.94	736,511.28	739,111.72	737,486.38
Northing	9,548,865.00	9,550,945.35	9,548,913.68	9,546,833.32
Elevation Range		1855	4675	
Model Rotation, Primary Axis = 128 degrees				
Block Size: 15m x 15m x 15 m				
220 Blocks on 128 Bearing				
176 Blocks on 38 Bearing				
188 Levels				

Big Gossan Model Area - Block Corners				
	Southwest	Northwest	Northeast	Southeast
Easting	734,261.04	734,559.64	735,599.81	735,301.21
Northing	9,548,674.60	9,549,056.79	9,548,244.11	9,547,861.93
Model Rotation, Primary Axis =		128 degrees		
Model Size	264 Blocks in 128 Bearing			
	97 Block in 38 Bearing			
	186 Levels			
	5x5x5 =Block Size			

8.1. GRSKL block model

- Block model size 15x15x15m; primary axis 128 degrees; 230 blocks on 128 bearing; 218 blocks on 38 bearing and 190 levels.
- Contains GBC and KL resources and block cave reserves.
- Mineralization is continuous between the two deposits. However, the minable envelopes for the KL and the GBC zones are not overlapping.
- Based on 15m composite grade with minimum recovered length of 4.5m of core. Grades outliers capped by estimation domains.
- Uses rock type (KL sedimentary units, GIC/Grasberg Intrusive Complex.), structural (regional) and alteration (pyrite) boundaries.
- GBC grades estimate: Applied a procedure called Locally Varying Anisotropy (LVA) to the Grasberg Intrusive Complex (GIC), used diamond drilling composites only. Other domains uses using ordinary linear kriging.
- KL grades estimate uses using ordinary linear kriging.
- Density estimated using ordinary linear kriging.
- Estimates of percent iron sulfide and iron oxide for input to process recovery calculations because pyrite affects recovery.
- Classification Codes based on the kriged variance of copper, the distance to the nearest composites, and the number of holes used for the estimate. Measured, indicated, and inferred.
- PTFI used net smelter return (NSR) to define mine planning and block economics rather than equivalent copper grade.
- Please refer to grskl_2019_model release note.doc for more detail information.

8.2. EESS block model

- Block model size 15x15x15m; primary axis 128 degrees; 253 blocks on 128 bearing; 176 blocks on 38 bearing and 193 levels.
- Contains DOZ, DMLZ reserves and DOM and GBOP/Ertsberg Resources
- Based on 15m composite grade with minimum recovered length of 4.5m of core. Grades outliers capped by estimation domains.
- Uses rock types (Waripi, Faumai, Kais, Sirga, Ertsberg Intrusive and Kembelangan Fm.) and a grade boundary (hard boundary @0.25% EqCu)
- Grades and density estimated using ordinary linear kriging.
- Classification Codes based on the kriged variance of copper, the distance to the nearest composites, and the number of holes used for the estimate. Measured, indicated, and inferred.
- Please refer to EESS_2019_Resource_Mod_release_notes_FINAL.doc for more detail information.

8.3. BG block model:

- Block model size 5x5x5m; primary axis 128 degrees; 264 blocks on 128 bearing; 97 blocks on 38 bearing and 186 levels.
- Based on 5m composite grade with minimum recovered length of 1.5m (30%) of core, and honored geological boundary. Grades outliers capped by estimation domains.
- Hosted in skarn altered limestone. Tabular deposit, dipping nearly vertical and striking 128 degrees. Mineralization is typically 20 to 60m wide and the known extent of mineralization is

over 1200m along strike and 650m vertically. Uses rock type, alteration type, breccia boundaries, structural zones and a grade (1% EQCU) boundaries.

- Grades and density estimated using ordinary linear kriging.
- Classification Codes based on the kriged variance of copper, the distance to the nearest composites, and the number of holes used for the estimate. Measured, indicated, and inferred.
- Open stopping with cemented paste backfill. The basic stope geometry is 15m along strike and 20m across strike with a height of 20m to 40m.
- Stope height depends on RQD. 20m (RQD 40-70%) and 40m (RQD>70%).
- Please refer to 2019_10k_Big_Gossan_Model_Construction_Notes_Summary_Final.Doc for more detail information.

9. Resources Estimation

9.1 Reasonable Prospect for eventual economic extraction

Table below and confirms that this material can be considered to have reasonable prospect for eventual economic extraction as required under KCMI code reporting standard. The Mineral Resources are additional to the Ore Reserves.

As of 31 December 2019, PTFI Mineral Resources are 2.68Bt at 0.67 % Copper, 0.59 g/t Gold and 3.57 g/t Silver containing metal 39.5 Blbs of Copper, 30.5 Moz of gold and 152.4 Moz of Silver.

Breakdown by deposit name shown on the table below.

Final Residual Resources at End-2019

Deposit Name	Notes	Total Mll Resource					Contained Metal		
WIUPK		Ore	Grades						
		Tonnes (thousand)	Copper %	Gold g/t	Silver g/t	EQ Copper %	Copper (million) Pounds	Gold (thousand) Troy oz	Silv (thousan Troy o
Dom Underground									
Block Cave Over-draw		6,828	0.66	0.17	4.16	0.76	98	37	91
Block Cave Scheduled		22,021	1.37	0.36	8.82	1.62	666	255	6,24
	Dom BC Subtotal	28,849	1.20	0.32	7.72	1.42	763	292	7,15
Dom Open Pit									
Open Pit Scheduled		23,850	2.03	0.43	12.13	2.45	1,068	327	9,22
Open Pit Low Grade	(<4% EQCu)	9,102	0.51	0.15	3.61	0.65	102	47	1,05
	Dom OP Subtotal	32,752	1.61	0.35	9.76	1.95	1,161	374	10,28
	Dom Total	61,601	1.42	0.34	8.80	1.70	1,924	666	17,43
Gunung Bijih Open Pit		13,753	0.86	0.29	3.65	1.07	260	130	1,61
Deep Ore Zone Block Cave		177,446	0.41	0.67	1.51	0.86	1,594	3,840	8,69
Deep Mill Level Zone Block Cave	(2515 to 2905 RL)	593,133	0.57	0.50	2.82	0.89	8,686	11,033	62,95
Big Gossan Open Stope	Marginal Stopes	19,761	1.33	0.69	8.74	1.73	579	440	5,55
Grasberg Underground									
Block Cave 2800		367,295	0.55	0.49	3.43	0.82	4,493	5,768	40,50
Block Cave Deep Cave	(2500 + 2600 footprints)	373,859	0.65	0.47	2.68	0.90	5,347	5,681	32,17
	GRS BC Subtotal	741,154	0.60	0.48	3.05	0.86	9,840	11,450	72,67
	GRS Total	741,154	0.60	0.48	3.05	0.86	9,840	11,450	72,67
Kucing Liar Block Cave									
Block Cave	(2500 + 2600m footprints)	973,194	0.77	0.74	4.44	1.07	16,624	23,262	138,81
	KL Subtotal	973,194	0.77	0.74	4.44	1.07	16,624	23,262	138,81
	WIUPK Total	2,680,041	0.67	0.59	3.57	0.97	39,507	50,821	307,67

Resource tonnage decreased by -76.7 Mt versus 2018 due to higher costs. Contained copper decreased by -1,188 Mlbs. Contained gold decreased by -1.482 Mozs. Contained silver decreased by -3.677 Mozs.

The metal price values used for 2019 resources are: $3/lb Cu, $1200/oz Au and $20/oz Ag. These prices were unchanged as compared to 2018 metal prices.

Detailed PTFI Mineral Resources evaluation as of December 31, 2019 available on this following file: end2019_reso_stmnt_24Jan2020_fnl.pdf.

9.2 Resources Classification

Resource confidence codes (measured, indicated, and inferred) were assigned to the block model based on parameters that reflect the spatial distribution of samples contributing to the estimate: the kriging variance (output from Cu estimation routines), a minimum of two holes used for measured and indicated, and the minimum distance to a sample. Inferred does not require multiple holes.

Identified Mineral Resources, In Addition to Reserves

Deposit	Measured Resources				Indicated Resources				Inferred Resources			
	Tonnes x 1000	Total Cu %	Gold gm/t	Silver gm/t	Tonnes x 1000	Total Cu %	Gold gm/t	Silver gm/t	Tonnes x 1000	Total Cu %	Gold gm/t	Silver gm/t
Dom Block Cave	8,800	1.37	0.34	8.80	20,049	1.13	0.30	7.24	0	0.00	0.00	0.00
Dom Open Pit + 0.40 Eqcu	7,426	1.71	0.37	10.73	24,731	1.59	0.36	9.64	595	0.86	0.08	2.88
Ertsberg Open Pit	2,242	1.24	0.33	4.56	11,511	0.78	0.29	3.48	0	0.00	0.00	0.00
DOZ Block Cave	25,927	0.42	0.84	1.34	150,852	0.41	0.65	1.55	666	0.41	0.22	0.65
DMLZ BC	22,999	0.56	0.62	2.72	560,861	0.59	0.53	2.94	89,273	0.44	0.22	2.12
Big Gossan	5,867	1.51	0.70	9.63	13,894	1.25	0.69	8.36	0	0.00	0.00	0.00
Grasberg 2800 Undercut	29,822	0.43	0.45	4.83	323,786	0.58	0.50	3.34	13,687	0.13	0.26	2.52
Grasberg Deep Cave	88,217	0.66	0.51	2.88	275,411	0.66	0.47	2.64	10,232	0.34	0.32	1.84
Kucing Liar BC	192,853	0.91	0.83	4.29	755,076	0.75	0.74	4.57	25,266	0.36	0.30	1.64
Total Identified Resources	384,154	0.80	0.69	4.02	2,156,170	0.66	0.59	3.59	139,718	0.39	0.25	2.04

10. Reserve Estimation

10.1 Modifying Factor

The Mineral Resources have been converted to Ore Reserves by means all Modifying Factors have been considered and determined a mine plan and scheduling that is technically achievable and economically viable.

PTFI Ore reserves is the economically minable part of a Measured and Indicated of our mineral resources. Modifying factor applied for the conversion: confidence level, geotechnical, mining cost, milling cost, draw point hurdle cost, metal prices, mill and smelter recoveries, smelting and refining charges, royalty and mining rights through 2041.

Cut off Grade (COG) based EqCu (Copper equivalent) was used in all mines. The cut-off grade was estimated using break even cost/profit estimation based on the estimated site operating costs, geotechnical and metallurgical factors.

2019 long-term metal price expectations used for reserves determination for copper, gold, and silver are US$2.5, $1200, and $15.

10.2 Reserve Classification

Resource confidence codes were assigned to the block model based on the kriging variance, the number of drill holes, and sample distance to the closest sample. The measured, indicated, and inferred confidence codes were defined.

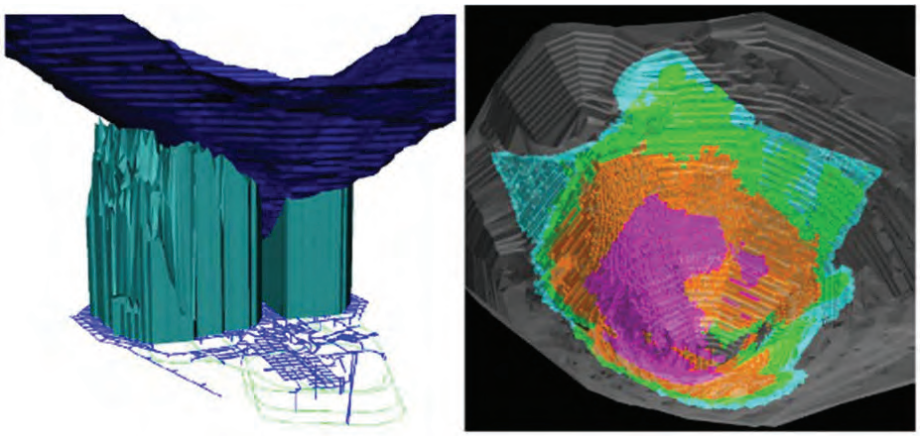
The measured and indicated coded blocks of the block models were used to determine reserves. Additionally rock mechanical and geo-metallurgy study have been carried out to assess cavebility of all block cave mines.

10.3 Ore Reserve Estimation

10.3.1 Grasberg Block Cave (GBC)

An economic block value approach to cutoff grade was utilized as applied at the other block cave deposits to establish the block cave reserve using the PCBC software as a guide and integrated with the procedure for estimating block cave dilution from the completed and overlying Grasberg open pit. The economic input for the GRS-BC incorporated a declining mining cost over time.

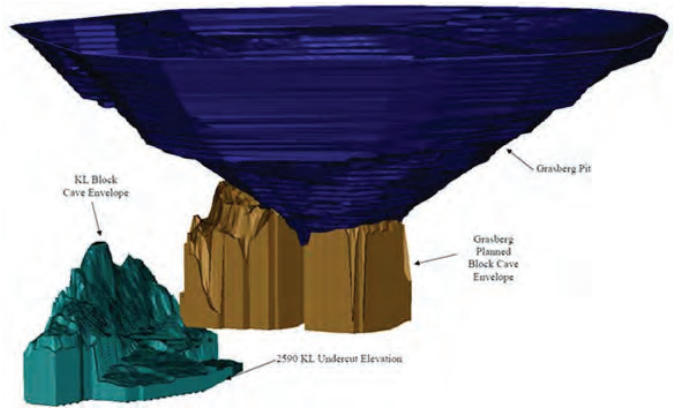
Picture on the left is GBC mineable envelope (green) looking North - North West and pit wall failure geometries color coded with 5 years increments looking North West.



10.3.2 Kucing Liar Block cave (KLBC)

Utilizes the PCBC routine to assist in the development and scheduling of planned block cave tonnage and grade inclusive of estimated dilution. Mine schedule was developed based on the 2019 block cave mining plan and schedule from PCBC. However, the last several years of that schedule extend beyond the time period of the IUPK. As a result, planned block cave production tonnage in years after 2041 were transferred to the resource category. Without extension to the IUPK, delays that trigger a reduction of the production tonnage at KL could potentially limit the future reserves and future economic viability of the KL deposit. Net smelter return (NSR) to define mine planning and block economics rather than equivalent copper grade. This decision is driven primarily by the use of variable process recoveries by metallurgical ore types.

Picture below shows KLBC and GBC minable envelopes perspective view looking West.



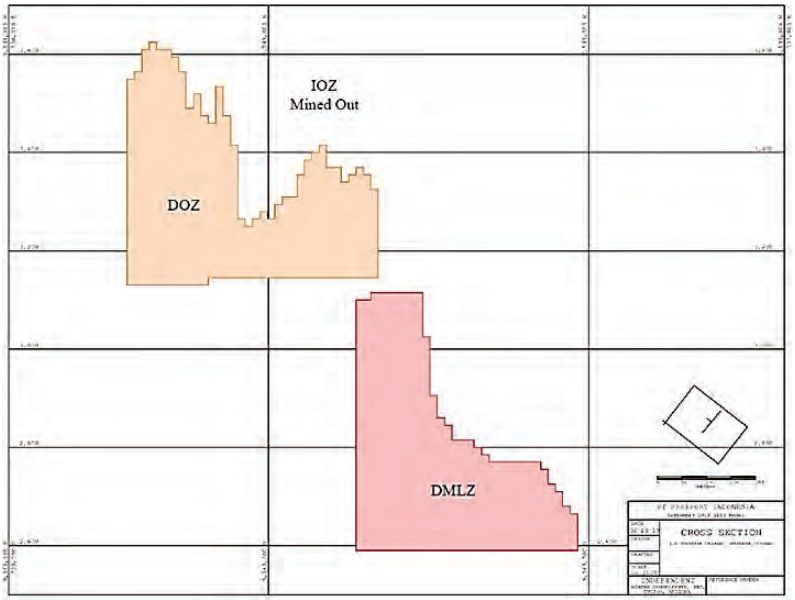
10.3.3 Deep Ore Zone (DOZBC)

Remaining reserves at DOZ are dependent on the geotechnical response of the cave. Some draw points have closed early or must be produced at a reduced rate due to wet muck and local draw point convergence. The reduced production rate could result in a loss of reserves. PTFI utilizes the PCBC routine to assist in the development of planned block cave tonnage and grade inclusive of estimated dilution. The economic input to the PCBC routine as applied by PTFI to set the cave envelope.

10.3.4 Deep Mill Level Zone (DMLZ BC)

The DMLZ extraction level is 530 meters below the DOZ extraction level and is transposed to the northeast, following the dip of the diorite contact. The DMLZ minable reserve and production schedule was established using the PCBC block cave scheduling routine. The economic input for the DMLZ incorporates a declining mining cost over time. The strategy employs a breakeven cutoff through about 2037 then the cutoffs reduce linearly until reaching an internal cutoff grade in 2041.

Cross section North West bellow shows the DOZ and DMLZ reserve areas.



10.3.5 Big Gossan (BG Open Stope)

The basic stope geometry is 15m along strike and 20m across strike with a height of 20m to 40m. Stopes are generally 40m high. When rock conditions are weaker the stope height is reduced to 20m. No stopes are planned for development if the model estimated RQD is less than 40%. The Big Gossan mine plan and minable reserve geometry are based on production plans that integrate a wide range of constraints into the operational plan including: geotechnical constraints, ventilation, drainage, material handling, and economics. Starting in 2016, a stope optimizer program called "Deswik" was used to determine the stope geometries and the mining reserve.

As of 31 December 2019, PTFI Ore Reserves are 1.81Bt at 1.04 % Copper, 0.79 g/t Gold and 4.70 g/t Silver containing payable metal 35.6 Blbs of Copper, 29.1 Moz of gold and 148.2 Moz of Silver. District reserves for all metals are lower than prior year values. Table below shows the breakdown by deposits.

Deposit	Ore				Mill Recoveries			Payable Metal		
	Tonnes x 1000	Total Copper %	Gold gm/t	Silver gm/t	Copper %	Gold %	Silver %	Copper Million Pounds	Gold Troy Oz X 1000	Silver Troy Oz X 1000
DOZ Block Cave	29,478	0.50	0.48	2.46	91.4%	84.6%	86.4%	287	374	1,549
Deep MLZ Block Cave	428,934	0.92	0.75	4.40	90.0%	81.5%	83.7%	7,557	8,213	39,039
Big Gossan	55,067	2.33	0.97	14.04	94.5%	69.8%	82.8%	2,579	1,166	15,821
Grasberg Pit	0	0.00	0.00	0.00	0.0%	0.0%	0.0%	0	0	0
Grasberg Pit, Stockpiles	0	0.00	0.00	0.00	0.0%	0.0%	0.0%	0	0	0
Grasberg Block Cave	959,328	0.97	0.73	3.67	87.1%	65.4%	72.2%	17,160	14,198	62,833
Kucing Liar	339,763	1.25	1.04	6.66	88.3%	46.7%	51.8%	7,982	5,136	28,959
Total Reserves	**1,812,571**	**1.04**	**0.79**	**4.70**	**88.5%**	**64.8%**	**70.4%**	**35,564**	**29,087**	**148,212**

Tonnes means metric tons = 2204.6 pounds
gm/t means grams per metric ton
Calculations on this table may not check precisely
because additional significant figures are stored and not printed.

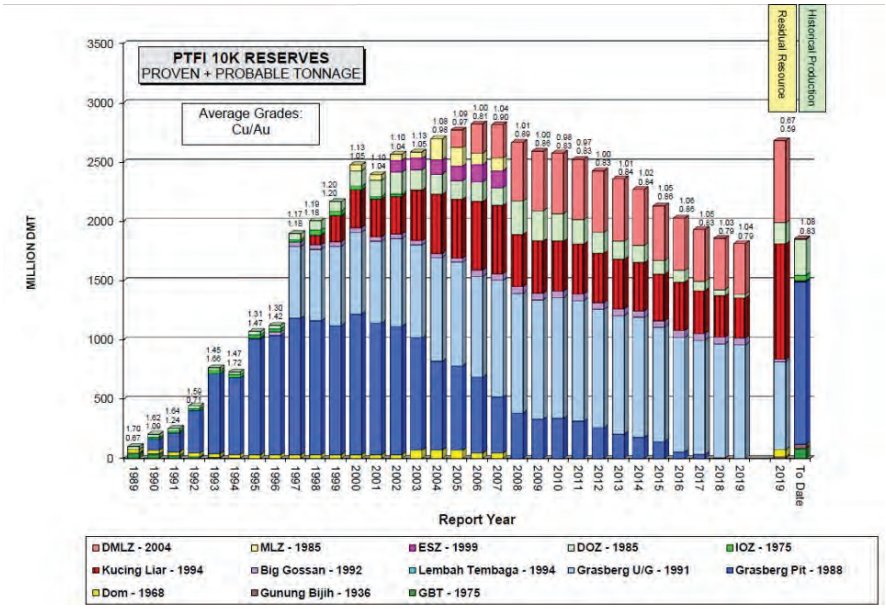
Mill Recoveries Shown on the Table, are Deposit Average Values and May Reflect Several Ore Types
Royalty calculations are not shown on this table.
Smelter Recoveries Shown Below, Applied to All Deposits

Metal	Smelter Recovery %
Copper	96.5%
Gold	97.0%
Silver	76.9%

Breakdown by confidence level following shown below.

Ore Reserves												
Deposit	Proven Reserves				Probable Reserves				Proven + Probable Reserves			
	Ore Tonnes x 1000	Total Cu %	Gold gm/t	Silver gm/t	Tonnes x 1000	Total Cu %	Gold gm/t	Silver gm/t	Tonnes x 1000	Total Cu %	Gold gm/t	Silver gm/t
DOZ Block Cave	8,088	0.55	0.56	2.60	21,390	0.48	0.45	2.41	29,478	0.50	0.48	2.46
Deep MLZ Block Cave	82,073	0.99	0.82	4.67	346,861	0.90	0.74	4.34	428,934	0.92	0.75	4.40
Big Gossan	17,494	2.55	1.03	15.71	37,573	2.22	0.95	13.26	55,067	2.33	0.97	14.04
Grasberg Pit									0	0.00	0.00	0.00
Grasberg Pit Stockpiles									0	0.00	0.00	0.00
Grasberg Block Cave	320,818	1.11	0.86	3.88	638,510	0.89	0.66	3.56	959,328	0.97	0.73	3.67
Kucing Liar	132,163	1.33	1.09	7.03	207,600	1.20	1.01	6.43	339,763	1.25	1.04	6.66
Total Reserves	**560,636**	**1.18**	**0.91**	**5.09**	**1,251,935**	**0.98**	**0.74**	**4.52**	**1,812,571**	**1.04**	**0.79**	**4.70**

PTFI reserves reduced by 56.5 million tonnes during 2019 of which 41.1 million tonnes was due to mining at the Grasberg Open Pit, the DOZ Block Cave, Big Gossan stope mine, the DMLZ and development mining continued at the GBC with production tonnage reported. KL reserve decreased due to the district mine schedule 2041 WIUPK expiration.



2019 long-term metal price expectations used for reserves determination changed from $2, $1000, and $15 for copper, gold, and silver, to $2.5, $1200, and $15. A reserves sensitivity analysis has been performed, which tests whether the current reserves are robust at the reserves' long-term metal prices, as compared to the 3-year average prices. The evaluation indicates that the long-term metal price expectations are lower than the 3-year average metal prices of 2.83 $/lb Cu, 1306 $/oz Au, and 16.32 $/oz Ag. The PV of the reserve at the long term metal prices is $126.04 billion, versus the 12% larger PV of $140.908 billion at the 3-year metal prices. The reserves are therefore robust with respect to the 3-year metals prices.

Detailed PTFI Ore Reserve evaluation as of December 31, 2019 available on this following file: end2019_rsrv_stmnt_24Jan2020_fnl.pdf

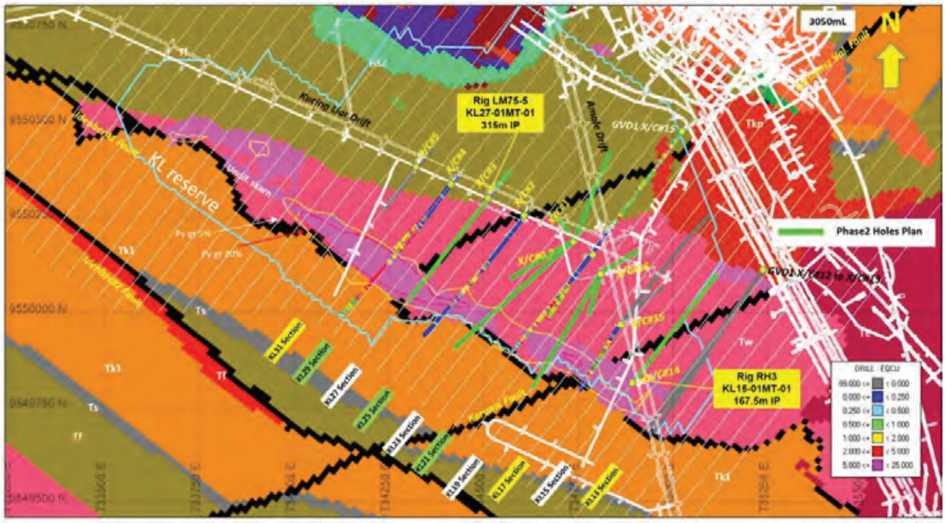
11 Exploration Targets

11.1 Figure Target/Prospect Location

No exploration program was recently carried out to add PTFI mineral resources or reserves. All carried out drilling inside the reserve shapes is a part of the ore body knowledge program designed to improve and optimize mining and ore recovery.

The KL drilling program is focusing on metallurgical response assessment. Phase 1 drilling with wider spacing of ~200m sections was competed in December 2019 with of 21 holes drilled totaling 9,785 meters. Phase 2, infill to 100 sections drill hole spacing is expected to be completed by the June 2020. Metallurgical and drop test (mill hardness) samples are collected for all material type units.

Plan map bellow shows the drilling program and progress as of December 2019.


3050mL
N
Kuring Liar Drift
Rig LM75-5
KL27-01MT-01
315m IP
Amole Drift
GVD1 X/C#15
KL reserve
Phase2 Holes Plan
GVD1 X/C#12 to X/C#13
Tkp
Tw
Tk1
Ts
Tf
Rig RH3
KL15-01MT-01
167.5m IP
KL31 Section
KL29 Section
KL27 Section
KL25 Section
KL23 Section
KL21 Section
KL19 Section
KL17 Section
KL15 Section
KL13 Section
DRILL : EQCU
-99.000 <= < 0.000
0.000 <= < 0.250
0.250 <= < 0.500
0.500 <= < 1.000
1.000 <= < 2.000
2.000 <= < 5.000
5.000 <= < 25.000
9550750 N
9550500 N
9550000 N
9549750 N
9549500 N

12. Competent Person Statements and KCMI Table 1

12.1 QP and CPI Statements:

PTFI Resource Evaluation

For the Year Ending December 31, 2019

January 27, 2020
Final

Prepared By: _____ Date: 01/27/2020
Name: Issel, Andrzej H.
Title: Director Resource Estimation and Reporting

Approved By: _____ Date: Feb 3, 2020
Name: Mark Johnson
Title: President & COO - Indonesia

Anton Perdana	Aulia Afwan	Nur Wiwoho D	Sugeng Widodo	Purwa Wiguna	E. Christiani Aloysius
PHE, ESM	ESM	PHE	PHE, ESM	ESM	EC

Printed: 1/27/2020 2:20 PM

PTFI Ore Reserves Evaluation

For the Year Ending December 31, 2019

January 27, 2020
Final

Prepared By: _____ Date: 01/27/2020
Name: Issel, Andrzej H.
Title: Director Resource Estimation and Reporting

Approved By: _____ Date: Feb 3, 2020
Name: Mark Johnson
Title: President & COO - Indonesia

Anton Perdana	Aulia Afwan	Nur Wiwoho D	Sugeng Widodo	Purwa Wiguna	E. Christiani Aloysius
PHE, ESM	ESM	PHE	PHE, ESM	ESM	EC

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12.2 KCMI Table 1

Criteria	*Explanation*	*PTFI*
Sampling Techniques and Data *(criteria in this group apply to all succeeding groups)*		
Sampling techniques.	□ *Nature and quality of sampling (e.g. cut channels, random chips etc.) and measures taken to ensure representativeness of the samples.*	• Diamond drilling is used to sample the deposit. Diamond drill core is sampled on 3m intervals for most drill programs. Sample intervals may be shorter than 3 meters if the geologist wishes to isolate a geologic contact or zone. • Diamond drilling is typically the highest quality drilling method for obtaining representative samples. Drill core samples allow direct observation of the ore mineral association with the gangue minerals. They also allow direct measurement of geologic, and geotechnical characteristics of the deposit. Chemical and physical characterization of the deposit are based on testing of these samples. • Diamond drilling is used to sample the deposit. Diamond drill core is sampled on 3m intervals. Drill core is split longitudinally using either an impact splitter or diamond sawing. The former method is by far the most common method used in the programs.
Drilling techniques.	□ *Drill type (e.g. core, reverse circulation, open-hole hammer, rotary air blast, auger, Bangka etc.) and details (e.g. core diameter, triple or standard tube, depth of diamond tails, face-sampling bit or other type, whether core is oriented and if so, by what method, etc).*	• Diamond drilling is the only drilling method used to derive samples for resource determination. • Core size used is variable and dependent on the equipment available and the length and orientation of the drill hole. Collar casings are commonly set using PQ HQ with HQ the preferred starting core diameter. Core diameter reduces down-hole as required by equipment capability or ground condition. • Core orienting and Televiewer has been carried out on selected holes through the history of the project. The methods used represent the range of techniques available to industry at the time, with no particular method considered a standard. Core orienting data has no effect on resource calculations, but can be used as a geotechnical input to pit or stope designs.

Sampling Techniques and Data *(criteria in this group apply to all succeeding groups)*		
Drill sample recovery.	□ *Whether core and chip sample recoveries have been properly recorded and results assessed.* □ *Measures taken to maximize sample recovery and ensure representative nature of the samples.* □ *Whether a relationship exists between sample recovery and grade and whether sample bias may have occurred due to preferential loss/gain of fine/coarse material.*	• Core recovery is calculated using the ratio of 'length of core recovered' to 'length of drilled interval'. Optimization of core recovery is addressed through use of larger core diameters, mud programs, and drilling rates. Studies have shown no significant bias exists between core recovery and grade. These studies show a strong correlation between accuracy and core recovery. Based on these studies, we allow the use of assay data for core recoveries as low as 30%.
Logging.	□ *Whether core and chip samples have been logged to a level of detail to support appropriate Mineral Resource estimation, mining studies and metallurgical studies.* □ *Whether logging is qualitative or quantitative in nature. Core (or trench, channel etc.)*	• All drill core undergoes detailed geological, mineralogical, and geotechnical logging to high industry standards. All logging information is stored digitally and is available as input to resource modelling and reserve determination processes. Mineralogy logging is quantitative and supported by XRD analysis of sample pulps on a 50m spacing. Geotechnical logging follows standard RQD and RMR methods. • All drill core is photographed in core trays prior to splitting. Core photographs are cataloged and stored digitally. Logging is carried out on the complete drill hole.

Sub-sampling techniques and sample preparation.	□ *If core, whether cut or sawn and whether quarter, half or all core taken.* □ *If non-core, whether riffled, tube sampled, rotary split etc. and whether sampled wet or dry.* □ *For all sample types, the nature, quality and appropriateness of the sample preparation technique.* □ *Quality control procedures adopted for all sub-sampling stages to maximize the representativeness of the samples.* □ *Measures taken to ensure that the sampling is representative of the in situ material collected.* □ *Whether sample sizes are appropriate to the grain size of the material being sampled.* □ *A statement as to the security measures taken to ensure sample integrity is recommended.*	• Drill core is split longitudinally using either an impact splitter or diamond sawing. The former method is by far the most common method used in the programs. Half of the core is placed into the original core tray. The other half of the core is placed in a cloth bag, labeled with a sample number, and submitted to a laboratory for preparation and analysis. Where taken, continuous chip (channel) samples are processed in total. The entire channel sample is placed in a cloth bag, labeled with a sample number, and submitted to a laboratory for preparation analysis. • Sample preparation techniques follow standard industry practice. Coarse samples are crushed to -4mm. The crushed material is blended and passed through a riffle splitter to obtain either a 1kg or 2kg mass, depending on lab capabilities. The excess crushed material is temporarily stored for potential future use. The crushed 2kg charge is pulverized using standard industry methods to 90% passing 2mm. Four craft paper pulp bags are labelled with the Sample ID and filled with pulverized material and typically contain 200 to 250 grams each. One pulp bag is submitted to the analytical laboratory and the others are stored. Excess pulp is discarded. Protocols are in place to test the efficacy of each size reduction stage and measure against the target grind. These data are evaluated and presented in monthly laboratory reviews. • Coarse blanks are inserted into the sample preparation process on a regular and continuing basis for all laboratories. Sample reduction protocols were defined to ensure appropriate mass vs size under prevailing sampling theory.

Quality of assay data and laboratory tests.	□ *The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total.* □ *Nature of quality control procedures adopted (e.g. standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (i.e.. lack of bias) and precision have been established.*	• Each pulp is analyzed for the reserve elements, and possibly for other attributes. Cu and Ag are determined using 2, 3, or 4 acid digestion, depending on the capabilities of the lab, chemistry of the ore, or other factors, and then analyzed by AAS or ICP methods. Au is determined by fire assay using a 15, 20, 30, or 50 g charge, depending on the sample matrix and coarseness of the gold. Final determination uses either AAS or Gravimetric finish, depending on the capabilities of the lab and the concentration of Au in the sample. The analytical techniques applied are all industry standard for the types of ores being tested. All analyses are considered 'total'. • No geophysical information are used to derive data is used as input to resource modelling or reserve determination. • QA/QC programs for analytical testing are in place for all projects and laboratories. These programs using standard protocols are evaluated regularly, and provide short-term feedback to the project owners and the analytical laboratory. Laboratory QC is accomplished using intralab replicates, interlab duplicates, and a standards program. Standards and duplicates are inserted into each sample batch.
Verification of sampling and assaying.	□ *The verification of significant intersections by either independent or alternative company personnel.* □ *The use of twinned holes.*	• Significant intersections are verified in the context of the mineralogy and by surrounding drill information. The type of mineralization (sulfides) makes simple visual verification by the geologic and engineering staff a simple matter. No separate protocols have been established. • Twinned holes are not routinely done, nor are they needed to confirm the visually obvious sulfide mineralization. All sampling and data processes are described in detailed Standard Operating Procedure (SOP) documents. The documents are reviewed and updated as needed. They are readily available on the company's intranet.

Location of data points.	□ *Accuracy and quality of surveys used to locate drill holes (collar and down- hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation.* □ *Quality and adequacy of topographic control.*	• There are a wide variety of drill hole survey techniques represented in the database. These, in order of perceived accuracy include, collar only, acid tube, single and multi-shot camera, maxi bore and gyroscopic downhole surveys. Older data is primarily acid tube survey, while newer data (later than 1996) is primarily maxi bore data, since 2013 gyroscopic downhole surveys predominate. Channel samples from mine workings are based on mine surveyor data. Channel samples from surface programs are based on geologic locations, and/ or surveyor locations. • The UTM (WGS84) coordinate system is used to collect primary location data. This information can be transformed to local coordinate systems when needed. Topographic control for the entire district is by LIDAR.
Data spacing and distribution.	□ *Data spacing for reporting of Exploration Results.* □ *Whether the data spacing and distribution is sufficient to establish the degree of geological and grade continuity appropriate for the Mineral Resource and Mineral Reserve estimation procedure(s) and classifications applied.* □ *Whether sample compositing has been applied.*	• A single Exploration drill hole whose results are considered 'Material' to the company or project can be released without requirement of additional drilling. Such announcements would not include tonnage and grade assessments. The data spacing is sufficient to establish geologic control and continuity. It is also sufficient to support both resource estimation and reserve determination. Data spacing is a major input to the classification of resource estimate. Data spacing is published in the company's 10K filing to the U.S. SEC. • Samples are composited to a nominal 3m lengh prior to preparation or analysis for ore elements. Composites of a minimum 0.5m length may be used in special cases. Compositing prior to analysis for other attributes may be done for metallurgical programs.
Reporting Archives	□ *Documentation of primary data, data entry procedures, data verification, data storage (physical and electronic) for preparing the report*	• Drill core from everywhere on the project site is transported to a core processing facility in Timika. The core tracking system is contained within the acQuire data base system and constitutes a thorough check list and reporting program to track the sample location and progress through transport, preparation, assay, and incorporation into the data base. • The assay, geology logging, rock mechanic logging, density measurement information is checked, stored and integrated into the acQuire computer data base system. • Data verification (sign off system) attached on every

		process from the sample location and progress through transport, preparation, assay and storage.
Orientation of data in relation to geological structure.	□ *Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type.* □ *If the relationship between the drilling orientation and the orientation of key mineralized structures is considered to have introduced a sampling bias, this should be assessed and reported if material.*	• The data is collected in quantity and density to allow for minimization of bias within the ore domains. Domain boundaries are established which minimize extrapolation beyond drilling limits.
Audits or reviews.	□ *The results of any audits or reviews of sampling techniques and data.*	• Audits of the company's laboratory QC data and sample protocols are conducted by outside reviewers on bi-annual basis. Internal audits of laboratory results may occur as frequently as monthly.

Reporting of Exploration Results *(criteria listed in the preceding group apply also to this group)*		
Mineral rights and land ownership.	□ *Type, reference name/number, location and ownership including agreements or material issues with third parties such as joint ventures, partnerships, overriding royalties, native title interests, historical sites, wilderness or national park and environmental settings* □ *The security of the tenure held at the time of reporting along with any known impediments to obtaining a license to operate in the area* □ *Location plans of mineral rights and titles. It is not expected that the description of mineral title in a technical report should be a legal opinion but should be a brief and clear description of such title as understood by the author.*	• PT-FI operates in the remote highlands of the Sudirman Mountain Range in the province of Papua, Indonesia, which is on the western half of the island of New Guinea. Since 1967, PT-FI and our predecessors have been the only operator of exploration and mining activities in the approximately 10,000 hectare operating area. • PT-FI is a limited liability company organized under the laws of the Republic of Indonesia. On December 21, 2018, Pt-FI completed the transaction with the Indonesian government regarding PT-FI's long-term mining rights and share ownership. Following the transaction, Freeport-McMoRan has a 48.76 percent share ownership in PT-FI and the remaining 51.24 percent share ownership is collectively held by PT Indonesia Asahan Aluminum (Persero) (PT Inalum), an Indonesian state-owned enterprise, and PT Indonesia Papua Metal Dan Mineral (PTI - formerly known as PT Indocopper Investama), which is expected to be owned by PT Inalum and the provincial/regional government in Papua, Indonesia. The arrangements related to the transaction also provide for Freeport-McMoRan and the other pre-transaction PT-FI shareholders to retain the economics of the revenue and cost sharing arrangements under the former Rio Tinto Joint Venture. As a result, Freeport-McMoRan economic interest in PT-FI is expected to approximate 81 percent through 2022. • IUPK. Concurrent with closing the transaction, the Indonesian government granted PT-FI an IUPK to replace its former COW, enabling PT-FI to conduct operations in the Grasberg minerals district through 2041. Under the terms of the IUPK, PT-FI has been granted an extension of mining rights through 2031, with rights to extend mining rights through 2041.
Exploration done by other parties.	□ *Acknowledgment and appraisal of exploration by other parties.*	• Not applicable. All historical exploration and appraisal has been done by Freeport-McMoRan entities.

Geology.	□ *Deposit type, geological setting and style of mineralization.* □ *Reliable geological maps and cross sections should exist to support interpretations.*	• The ore bodies are located within and around two main igneous intrusions, the Grasberg monzodiorite and the Ertsberg diorite. The host rocks of these ore bodies include both carbonate and clastic rocks that form the ridge crests and upper flanks of the Sudirman Range, and the igneous rocks of monzonitic to dioritic composition that intrude them. The igneous-hosted ore bodies (the Grasberg Block Cave, and portions of the DOZ) occur as vein stockworks and disseminations of copper sulfides, dominated by chalcopyrite and, to a lesser extent, bornite. The sedimentary-rock hosted ore bodies (portions of the DOZ and all of the Big Gossan) occur as "magnetite-rich, calcium/magnesian skarn" replacements, whose location and orientation are strongly influenced by major faults and by the chemistry of the carbonate rocks along the margins of the intrusions. • The copper mineralization in these skarn deposits is dominated by chalcopyrite, but higher bornite concentrations are common. Moreover, gold occurs in significant concentrations in all of the district's ore bodies, though rarely visible to the naked eye. These gold concentrations usually occur as inclusions within the copper sulfide minerals, though, in some deposits, these concentrations can also be strongly associated with pyrite. • Reliable geological maps, cross sections and 3D geology model exist to support interpretations.
Data aggregation methods.	□ *In reporting Exploration Results, weighting averaging techniques, maximum and/or minimum grade truncations (e.g. cutting of high grades) and cut-off grades are usually material and should be stated.* □ *Where aggregate intercepts incorporate short lengths of high-grade results and longer lengths of low grade results, the*	• Not applicable; this report deals with a Mineral Resource and Ore Reserve estimate.

	procedure used for such aggregation should be stated and some typical examples of such aggregations should be shown in detail. *The assumptions used for any reporting of metal equivalent values should be clearly stated.*	
Relationship between mineralization widths and intercept lengths.	*These relationships are particularly important in the reporting of Exploration Results.* *If the geometry of the mineralization with respect to the drill hole angle is known, its nature should be reported.* *If it is not known and only the down-hole lengths are reported, there should be a clear statement to this effect (e.g. 'downhole length, true width not known').*	• Not applicable; this report deals with a Mineral Resource and Ore Reserve estimate.
Diagrams.	*Where possible, maps and sections (with scales) and tabulations of intercepts should be included for any material discovery being reported if such diagrams significantly clarify the report.*	• Not applicable; this report deals with a Mineral Resource and Ore Reserve estimate.

Balanced reporting.	□ *Where comprehensive reporting of all Exploration Results is not practicable, representative reporting of both low and high grades and/or widths should be practiced to avoid misleading reporting of Exploration Results.*	• Not applicable; this report deals with a Mineral Resource and Ore reserves estimate.
Other substantive exploration data.	□ *Other exploration data, if meaningful and material, should be reported including (but not limited to): geological observations; geophysical survey results; geochemical survey results; bulk samples – size and method of treatment; metallurgical test results; bulk density, groundwater, geotechnical and rock characteristics; potential deleterious or contaminating substances.*	Not applicable; this report deals with a Mineral Resource and Ore reserves estimate.
Further work.	□ *The nature and scale of planned further work (e.g. Tests for lateral extensions or depth extensions or large-scale step-out drilling).*	Not applicable; this report deals with a Mineral Resource and Ore reserves estimate.

Estimation and Reporting of Mineral Resources *(criteria listed in the first group, and where relevant in the second group, apply also to this group)*		
Database integrity.	□ *Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes.* □ *Data validation procedures used.*	• PTFI geology database stores data in an acQuire SQL database system. • Data is logged directly into the database utilizing wireless transfer protocols. • Validation checks are written into the SQL Server database and these are activated via database and user triggers to ensure the data is correct with respect to fundamental quality issues. • Read/write privileges of the primary tables in the database are controlled through the use of security group permissions. Individual user profiles restrict the data that can be accessed and altered. • The database has a log backup each hour by our IT department. A complete backup is completed each night.
Geological Interpretation.	□ *Confidence in (or conversely, the uncertainty of) the geological interpretation of the mineral deposit.* □ *Nature of the data used and of any assumptions made.* □ *The effect, if any, of alternative interpretations on Mineral Resource estimation.* □ *The use of geology in guiding and controlling Mineral Resource estimation.* □ *The factors affecting continuity both of grade and geology.*	• The confidence of regional geological interpretation is very good, supported by well-spaced drilling with high-quality geo logging information. Underground and surface mapping increases local confidence. Interpretation changes from additional data are updated every quarter. • The 3D geologic wireframes are used for flagging the assay composite, and block model as geologic domains in the resource estimation. • Mineralization is generally consistent along N038E strike and down dip. Mineralized envelopes for copper mineralization were modelled from drill sections using geological logging interpretations, copper grades (mineralized and non-mineralized zones). All mineralization envelopes were reviewed in 3D to ensure that they were consistent with the overall geological framework of the deposits.

Dimensions.	□ *The extent and variability of the Mineral Resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.*	Multiple lenses exist within a mineralized zone having a plan width (across strike) of approximately 300-400m. Only a subset of this mineralized zone has sufficient continuity of grade to have been reported as a Mineral Resource. • GBC is the same ore body historically mined from the Grasberg open pit, Mineral Resources continue downward to 2500m elevation. • KLBC, 600m below the topography, Mineral Resource ranges from 3200 to 2500m elevation. • DOZ, 400m below the surface, lies vertically below the now depleted Intermediate Ore Zone (IOZ), Mineral Resource ranges from 3700 to 3100m elevation level. • DMLZ ore body lies bellow the DOZ, approximately 1000m below the surface, and mineralization ranges from 3100 to 2500m elevation that represents the downward continuation of mineralization in the Ertsberg East Skarn system and neighboring Ertsberg porphyry. • BG Resources, 450m below the surface, tabular deposit, dipping nearly vertical and striking 128 degrees. Mineralization is typically 20 to 60m wide and the known extent of mineralization is over 1200m along strike and 650m vertically (3300-2500m). • DOM, Mineral Resource ranges from surface 4500m to 3800m elevation, two mining methods Open pit and Block cave. • GBOP/Ertsberg, Mineral Resource continued from surface 3900 to 3450m elevation.
Estimation and modelling techniques.	□ *The nature and appropriateness of the estimation technique(s) applied and key assumptions,*	Three resource block models provided: 1) GRSKL (for GBC and KLBC deposits), 2) EESS (for DOZ, DMLZ, GBOP and DOM deposits), and BG (for Big Gossan deposit)

	including treatment of extreme grade values, domain, interpolation parameters, maximum distance of extrapolation from data points. □ *The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data.* □ *The assumptions made regarding recovery of by-products.* □ *Estimation of deleterious elements or other non-grade variables of economic significance (e.g. sulphur for acid mine drainage characterization).* □ *In the case of block model interpolation, the block size in*	GRSKL block model • Updated on annual basis (June - August) • Block model size 15x15x15m; primary axis 128 degrees; 230 blocks on 128 bearing; 218 blocks on 38 bearing and 190 levels. • Contains GBC and KL resource and block cave reserves. • Mineralization is continuous between the two deposits. However, the minable envelopes for the KL and the GBC zones are not overlapping. • Based on 15m composite grade with minimum recovered length of 4.5m of core. Grades outliers capped by estimation domains. • Uses rock type (KL sedimentary units, GIC/Grasberg Intrusive Complex.), structural (regional) and alteration (pyrite) boundaries. • GBC grades estimate: ordinary kriging procedure with Locally Varying Anisotropy (LVA) to the Grasberg Intrusive Complex (GIC),. Other domains uses using ordinary linear kriging. All estimated domains are using diamond-drilling composites. KL grades estimate uses using ordinary linear kriging. • Density estimated using ordinary linear kriging. • Estimates of percent iron sulfide and iron oxide for input to process recovery calculations because KL contains zones where pyrite affects recovery. • Classification Codes based on the kriged variance of copper, the distance to the nearest composites, and the number of holes used for the estimate. Measured, indicated, and inferred. PTFI used net smelter return (NSR) to define mine planning and block economics rather than equivalent copper grade. • Please refer to grskl_2019_model release note.doc for more detail information.

	relation to the average sample spacing and the search employed. *Any assumptions behind modelling of selective mining units.* *Any assumptions about correlation between variables.* *The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available.* *Detailed description of the method used and the assumptions made to estimate tonnages and grades (section, polygon, inverse distance, geostatistical, or other method)* *Description of how the geological interpretation was used to control the resource estimates.* *· Discussion of basis for using or not using grade cutting or capping. If a computer method was chosen, description of programs and parameters used.* *· Geostatistical methods are*	EESS block model • Updated on annual basis (June - August) • Block model size 15x15x15m; primary axis 128 degrees; 253 blocks on 128 bearing; 176 blocks on 38 bearing and 193 levels. • Contains DOZ, DMLZ reserves and DOM and GBOP/Ertsberg Resources • Based on 15m composite grade with minimum recovered length of 4.5m of core. Grades outliers capped by estimation domains. • Uses both rock type (Waripi, Faumai, Kais, Sirga, Ertsberg Intrusive and Kembelangan Fm.) and grade boundary (hard boundary @0.25EqCu) • Grades and density estimated using ordinary linear kriging. • Classification Codes based on the kriged variance of copper, the distance to the nearest composites, and the number of holes used for the estimate. Measured, indicated, and inferred. • Please refer to EESS_2019_Resource_Mod_release_notes_FINAL.doc for more detail information. BG (BG block model): • Updated on annual basis (August) • Hosted in skarn altered limestone. Tabular deposit, dipping nearly vertical and striking 128 degrees. Mineralization is typically 20 to 60m wide and the known extent of mineralization is over 1200m along strike and 650m vertically. • Block model size 5x5x5m; primary axis 128 degrees; 264 blocks on 128 bearing; 97 blocks on 38 bearing and 186 levels. • Based on 5m composite grade with minimum recovered length of 1.5m (30%) of core, and honored geological boundary. Grades outliers capped by estimation domains. • Uses rock type, alteration type, breccia boundaries, structural zones and a grade (1% EQCU) boundaries. • Grades and density estimated using ordinary linear kriging. • Classification Codes based on the kriged variance of copper, the distance to the nearest composites, and the number of holes used for the estimate. Measured, indicated, and inferred. • Open stopping with cemented paste backfill. The basic stope geometry is 15m along strike and 20m

	extremely varied and should be described in detail. The method chosen should be justified. The geostatistical parameters, including the variogram, and their compatibility with the geological interpretation should be discussed. Experience gained in applying geostatistics to similar deposits should be taken into account.	across strike with a height of 20m to 40m. • Stope height depends on RQD. 20m (RQD 40-70%) and 40m (RQD>70%). • Please refer to 2019_10k_Big_Gossan_Model_Construction_Notes_ Summary_Fina l.Doc for more detail information.
Moisture.	*Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.*	• Tonnage estimates are on a dry basis.
Cut-off parameters.	*The basis of the adopted cut-off grade(s) or quality parameters applied.*	• Cut-off-grade (COG) for each deposit is based on percent of Cu equivalent that includes equation using Au and Ag credits. • Block cave mining uses two CoG to determine the residual resources; the depleted CoG for any material inside the reserve shape and in-situ break even CoG for the material outside the reserve shape. • Stope mining uses in-situ break even CoG.

Mining factors or assumptions.	□ *Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It may not always be possible to make assumptions regarding mining methods and parameters when estimating Mineral Resources. Where no assumptions have been made, this should be reported.* □ *In order to demonstrate realistic prospects for eventual economic extraction, basic assumptions are necessary. Examples include access issues (shafts, declines, etc.), geotechnical parameters (pit slopes, stope dimensions etc.), infrastructure requirements and estimated mining costs. All assumptions should be clearly stated.*	• The DOZ, DMLZ, GBC and KLBC deposits area large, medium-high grade copper-gold-silver deposit a minable to bulk mining/low selectivity mining methods. Given the top of the deposit is >500m below surface, block caving is considered the only feasible mining method. • The low level of selectivity of block cave mining is accounted by the inclusion of internal mining dilution in the declared Mineral Resource estimate. • The block cave mining method is reasonable and has "reasonable prospects for eventual economic extraction". • The high grade tabular BG deposit is typically 20 to 60m wide and the known extent of mineralization is over 1200m along strike and 650m vertically. Open stopping with cemented paste backfill is considered the only feasible mining method. • The high level of selectivity of stope mining will limit the internal mining dilution in the declared Mineral Resource estimate. • The stope mining method is reasonable and has "reasonable prospects for eventual economic extraction".
Metallurgical factors or assumptions.	□ *The basis for assumptions or predictions regarding metallurgical amenability. It may not always be possible to make*	• Metallurgical test work indicates that the deposit are minable to both traditional comminution and floatation process. The results of the metallurgical test work has "reasonable prospects for eventual economic extraction".

	assumptions regarding metallurgical treatment processes and parameters when reporting Mineral Resources. Where no assumptions have been made, this should be reported.	
Bulk density.	□ *Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples.*	• Dry bulk density (SG) was determined by following process: - A piece of core from each sampled value is weighed in air and weighed again suspended in water providing a Bulk or SG for that piece of core. Core not sampled is measured every three meters and added to the database with the sampled intervals. Weight in air/(weight in air–weight in water) = SG. - A sample bias (BulkF) occurs because weighing crushed or highly altered rock is difficult so the sampler chooses solid rocks to weigh. A factor applied to the bulk measurement compensates for sample bias. The factor considers RQD, broken and crushed measurements. - A default value for blocks outside sample influence is applied based upon the mean, median and correlation coefficient for each zone. - Bulk SG measured every three meters of drill core are composited into 15m. Bulk is capped at the assay level with minimum value of 1.8 and a maximum value of 5.5 SG. BulkF is capped at the assay level with a minimum value of 0.85 and a maximum value of 0.985.

Classification.	□ *The basis for the classification of the Mineral Resources into varying confidence categories.* □ *Whether appropriate account has been taken of all relevant factors. i.e. relative confidence in tonnage/grade computations, confidence in continuity of geology and metal values, quality, quantity and distribution of the data.* □ *Whether the result appropriately reflects the CPI's view of the deposit.*	• The classification of the Mineral Resources is based upon the confidence in the geological and grade continuity established by the existing data spacing, number of drill holes used, kriging variance and quality. • The classification also accounts for the likely mining method (large, bulk mining mining/low selectivity) and an assessment of the "reasonable prospects for eventual economic extraction" guidelines of the KCMI Code (2017). • An assessment of grade and geological continuity is based upon the following: - Continuity of the geological data and interpreted 3D geological model; - Spatial continuity studies of the assay data; - Visual inspection of the variation in both assay and geological data in 3D space; and - Studies evaluating the change in the Mineral Resource estimate based upon differing data densities. • Appropriate account was made for all relevant factors. • The results of the Mineral Resource classification reflect the Competent Person's view on the confidence in the geological and grade continuity exhibited by the existing data.
Audits or reviews.	□ *The results of any audits or reviews of Mineral Resource estimates.*	• Internal peer reviews within the company have been undertaken of the Mineral Resource Estimate. These reviews did not identify any significant issues with the Mineral Resource estimates. • An independent resource estimate was developed by external auditor Independent Mining Consultant, Inc. (IMC). This showed that there were no significant differences between estimates. It was concluded that the resource estimate has been performed in a manner consistent with good engineering and geologic practice.

Discussion of relative accuracy/confidence.	□ *Where appropriate a statement of the relative accuracy and/or confidence in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person Indonesia. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate.* □ *The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages or volumes, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used.*	• The confidence level in the Mineral Resource estimate is reflected in the classification of the resource. • The relative accuracy of the estimate within confidence limits has not been quantified. • Given that the deposit will be exploited by bulk mining methods, with very little selectivity, and that the grade distributions are not overly skewed, then grade estimates into large volumes of material is considered accurate. This provides confidence that the current estimate of resource and its grades is accurate within the constraints of the KCMI Code (2017) definitions of the various Mineral Resource categories. • The Mineral Resource estimate is presented as a global estimate of both tonnage and grade. This reflects the low selective/bulk mining method (block caving) and open stop mine that is considered the most appropriate mining method. • Relative accuracy and confidence of the resource estimate was not compared with production data. Reconciliation against production data is done on the reserve estimate.

	□ *These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.*	

Estimation and Reporting of Mineral Reserves

(criteria listed in the first group, and where relevant in other preceding groups, apply also to this group)

Mineral Resource estimate for conversion to Mineral Reserves.	□ *Description of the Mineral Resource estimate used as a basis for the conversion to a Mineral Reserve.* □ *Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Mineral Reserves.*	• PTFI Ore reserves is the economically minable part of a Measured and Indicated of our Mineral resources. Modifying factor applied for the conversion: confidence level, geotechnical, mining cost, milling cost, drawpoint hurdle cost, metal prices, mill and smelter recoveries, smelting and refining charges, royalty and mining rights through 2041 • The Mineral Resources are additional to the Ore Reserves.
Study status.	□ *The type and level of study undertaken to enable Mineral Resources to be converted to Mineral Reserves.* □ *The Code does not require that a final feasibility study has been undertaken to convert Mineral Resources to Mineral Reserves, but it does require that at least Pre-Feasibility level*	• The Ore Reserve estimate is an update to the Definitive Feasibility Study: - DOZ, DOZ/ESZ 80,000 TPD Expansion Feasibility Study-Aug07; - DMLZ, DMLZ Mine Feasibility Study-Sep-09; - BG, Feasibility Study for the Big Gossan Mine-Mar-05; - GRS Block Cave (GBC), Grasberg Block Cave Feasibility Study, Mar-08; - - KL, Kucing Liar Mine Design Update Study, Nov-09. • Material, even if within the Mineral Resources that have not been planned to be mined at the LOM -plan (dilutions) have not been included in the Ore Reserves. • The Mineral Resources have been converted to Ore Reserves by means all modifying factors have been

	will have determined a mine plan that is technically achievable and economically viable, and that all Modifying Factors have been considered.	considered and determined a mine plan and scheduling that is technically achievable and economically viable.
Cut-off parameters.	□ *The basis of the cut-off grade(s) or quality parameters applied.*	• COG based EqCu (Copper equivalent) was used. The cut-off grade was estimated using break even cost/profit estimation based on the estimated site operating costs, geotechnical and metallurgical factors. • 2019 long-term metal price expectations used for reserves determination for copper, gold, and silver are $2.5, $1200, and $15.
Mining factors or assumptions.	□ *The method and assumptions used to convert the Mineral Resource to a Mineral Reserve (i.e. either by application of appropriate factors by optimization or by preliminary or detailed design).* □ *The choice of, the nature and the appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc.* □ *The assumptions made regarding geotechnical parameters (e.g. pit slopes, stope sizes, etc.), grade control*	• Conventional UG Loader and Remote UG Loader have been selected as the most suitable mining method for All PTFI deposits. • A Rock mechanical and geo-metallurgy study have been carried out to estimate the cavability of All UG mines. • Detail modifying factor for each mine is available on the Feasibility Study document.

	and pre-production drilling. □ *The major assumptions made and Mineral Resource model used for pit optimization (if appropriate).* □ *The mining dilution factors, mining recovery factors, and minimum mining widths used.* □ *The infrastructure requirements of the selected mining methods.*	
Metallurgical factors or assumptions.	□ *The metallurgical process proposed and the appropriateness of that process to the style of mineralization.* □ *Whether the metallurgical process is well-tested technology or novel in nature.* □ *The nature, amount and representativeness of metallurgical test work undertaken and the metallurgical recovery factors applied.* □ *Any assumptions or allowances made for deleterious elements.* · *The existence of any bulk sample or pilot scale test work and the degree to which such samples are representative of the*	• The production process consists of the following main functions: mining, crushing, and milling. The basic reference recovery is based on geometallurgical tests. As this is done at laboratory scale and in an open circuit, scale-up parameters are applied to get copper, gold and silver recovery for targeted concentrate grade in full scale. Also mass pull (mass proportion of concentrate compared to the ore/block/plant feed. • The concentrate with targeted grade is further processed by smelting. • Deleterious elements are not assumed to be present or identified in tests.

	orebody as a whole.	
Cost and revenue factors.	□ *The derivation of, or assumptions made, regarding projected capital and operating costs.* □ *The assumptions made regarding revenue including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, etc.* □ *The allowances made for royalties payable, both Government and private.*	• Operating cost are establish to historic production and engineering cost. Operating costs are derived from historic costs and reasonable projections of future costs, both fixed and variable. Head grade of Cu, Au, and Ag are derived from assays of drill core validated by reconciliation of mine to mill grades over several years. Metal prices and exchange rates come from the studies conducted by the treasury department. Transportation, treatment charges and penalties consider historic expenses and forward looking assumptions. Capital costs include development of infrastructure, replacement capital and projects such as the smelter and mill retrofitting to maximize expected changes in ore feed and environmental expectations. Royalties and taxes are deducted from expected revenue.
Market assessment.	□ *The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future.* □ *A customer and competitor analysis along with the identification of likely market*	• Market assessment is available on this following document in the internet https://investors.fcx.com/investors/financial-information/annual-reports-and-proxy/default.aspx

	windows for the product. *□ Price and volume forecasts and the basis for these forecasts.* *□ For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.*	
Other.	*□ The effect, if any, of natural risk, infrastructure, environmental, legal, marketing, social or governmental factors on the likely viability of a project and/or on the estimation and classification of the Mineral Reserves.* *□ The status of titles and approvals critical to the viability of the project, such as mining leases, discharge permits, government and statutory approvals.*	• All risks identified and explained on this following document in the internet https://investors.fcx.com/investors/financial-information/annual-reports-and- proxy/default.aspx
Classification.	*□ The basis for the classification of the Mineral Reserves into varying confidence categories.* *□ Whether the result appropriately reflects the CPI's view of the deposit.* *□ The proportion of Probable Mineral Reserves, which have been derived from*	• Ore reserves have been classified to Proven and Probable categories based on Resource confidence codes that are assigned to the block model based on the kriging variance, number of drill holes, and sample distance to the closest sample used in the estimation. • No conversion from indicated mineral resource into proven ore reserve was made. • Conversion from measured mineral resource into probable ore reserve was made for all material within the block cave reserves. • The ore reserves of the deposits appropriately reflect the Competent Person's view of the deposit.

	Measured Mineral Resources (if any).	
Audits or reviews.	□ *The results of any audits or reviews of Mineral Reserve estimates.*	• Independent Mining Consultants, INC (IMC) has reviewed the ore reserve calculations and found them to be rightly estimated.
Discussion of relative accuracy/confidence .	· *Where appropriate a statement of the relative accuracy and/or confidence in the Mineral Reserve estimate using an approach or procedure deemed appropriate by the Competent Person Indonesia. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate.* · *The statement should specify whether it relates to global or local estimates, and, if*	• It is Competent Person's view that the quality and accuracy of the modifying factors are appropriate. • Variance of dilution and head grade has an effect on the total process recovery. The previously mentioned factors need to be considered in short term mine planning. • Metal reconciliation of ore reserve to mine and mill is conducted monthly to monitor accuracy of estimation and improve confidence of the mineral reserve.

	local, state the relevant tonnages or volumes, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used. *These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.*	

ISSUER

PT Indonesia Asahan Aluminium (Persero)
The Energy Building, 16th Floor
Sudirman Central Business District
Jl. Jend. Sudirman Kav. 52-53
Jakarta 12190, Indonesia

LEGAL ADVISORS TO THE ISSUER

as to New York and U.S. federal securities law:
Sidley Austin LLP
Level 31
Six Battery Road
Singapore 049909

as to Indonesian law:
Assegaf Hamzah & Partners
Capital Place, Level 36 & 37
Jl. Jend. Gatot Subroto Kav. 18
Jakarta 12710, Indonesia

LEGAL ADVISORS TO THE JOINT BOOKRUNNERS

as to New York and U.S. federal securities law:
Linklaters Singapore Pte. Ltd.
One George Street
#17-01
Singapore 049145

as to Indonesian law:
Widyawan & Partners
The Energy Building, 9th Floor
Sudirman Central Business District
Jl. Jend. Sudirman Kav. 52-53
Jakarta 12190, Indonesia

INDEPENDENT ACCOUNTANTS

to the Issuer:
Kantor Akuntan Publik Tanudiredja, Wibisana, Rintis & Rekan
(a member of the PricewaterhouseCoopers network of firms)
World Trade Center 3
Jl. Jend. Sudirman Kav. 29-31
Jakarta 12920, Indonesia

to PTFI:
Kantor Akuntan Publik Purwantono, Sungkoro & Surja
(a member firm of Ernst & Young Global Limited)
Indonesia Stock Exchange Building
Tower 2, 7th Floor
Jl. Jend. Sudirman Kav. 52-53
Jakarta 12190, Indonesia

TRUSTEE, PAYING AGENT, TRANSFER AGENT AND REGISTRAR

The Bank of New York Mellon
240 Greenwich Street
New York, NY 10286
United States of America

PT INDONESIA ASAHAN ALUMINIUM (PERSERO)

(a state-owned company incorporated in the Republic of Indonesia with limited liability)

US$1,000,000,000 4.750% Notes due 2025
US$1,000,000,000 5.450% Notes due 2030
US$500,000,000 5.800% Notes due 2050

Issue Price for the 2025 Notes: 99.015%
Issue Price for the 2030 Notes: 97.742%
Issue Price for the 2050 Notes: 92.981%

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