

CONFIDENTIAL

NICKEL ACID LEACHING PROCESSING PLANT PROJECT

In Central Sulawesi, Indonesia

PROJECT INFORMATION MEMORANDUM

Presented to

PT. Burmi Persada Surya Pratama

by
Usep Hidayat

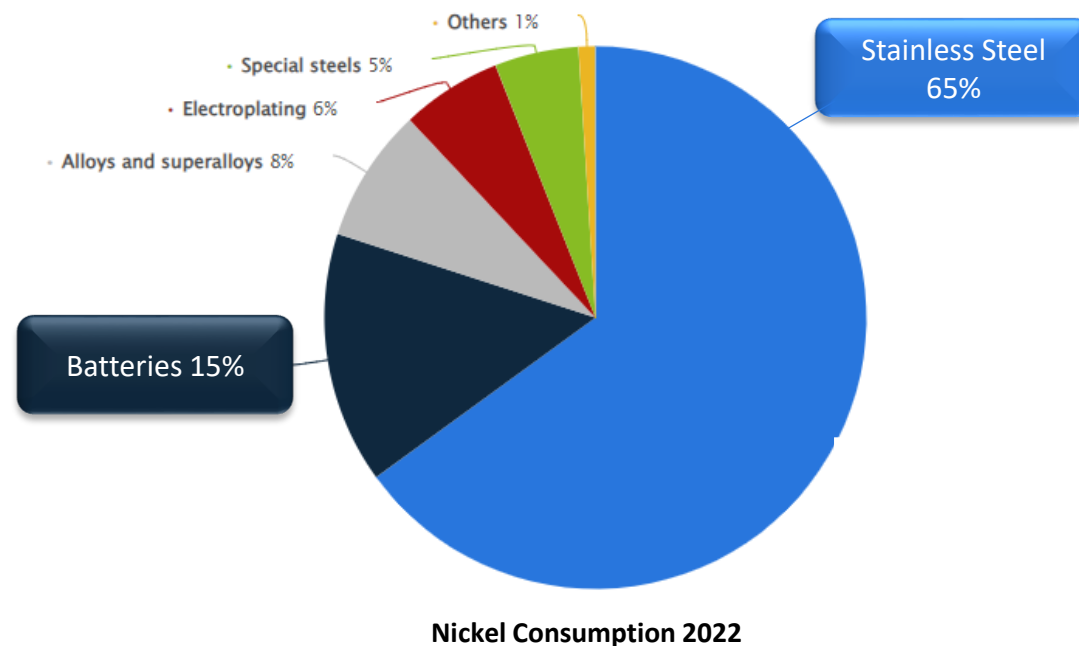


OCTOBER 2024

PT. INDUSTRI NIKEL HIDROKSIDA

Nickel Market Insight and Prospect

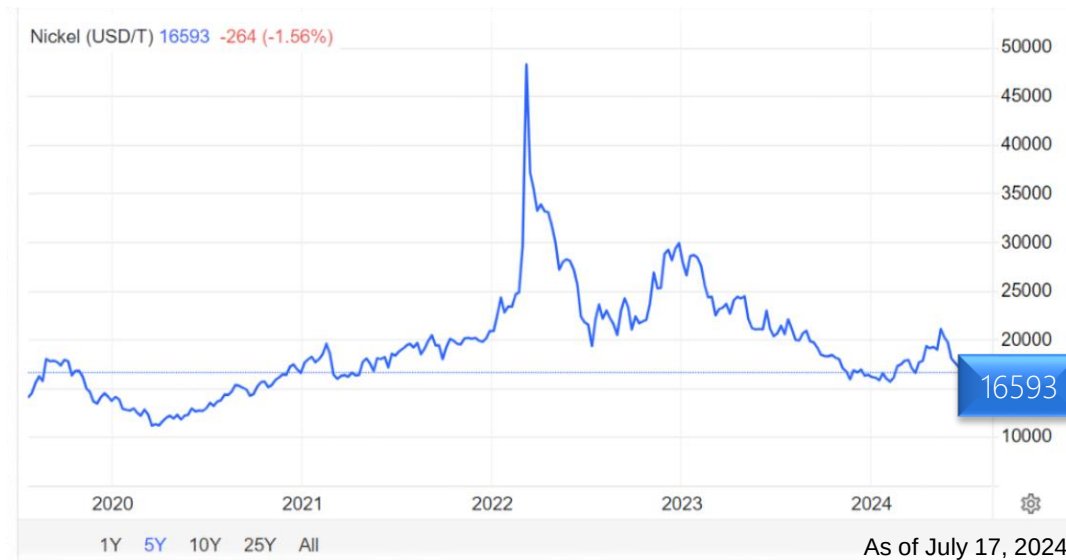
- The global nickel market size was estimated at USD 33.05 billion in 2022 and is projected to grow at a compound annual growth rate (CAGR) of 7.98% from 2022 to 2028
- Nickel Market Trends/Drivers:
 - Growing demand in the stainless steel industry
 - Increasing adoption of EVs and nickel-rich batteries
 - Infrastructure development and urbanization
- Supply Issues:
 - Nickel production significantly increased recently, but supply uncertainties remain due to environmental regulation and political instability
- Price Volatility:
 - Nickel prices are highly volatile due to market demand
 - Supply imbalances, speculative trading, and unstable global economic conditions



➡ Long-term demand for stable and reliable nickel production & supply continues in the market

Nickel Price Forecast (2024-2050)

- Overall, the outlook for nickel prices is bullish over the next several decades. The price is expected to double by 2050 from the current forecast for 2024, which is around \$16,800 according to ING think tank.
- Fluctuations are expected to continue around \$16,000-17,000 in 2025, with prices potentially ranging between \$20,000 and \$30,000 by 2030-2040, mainly driven by the anticipated rise in EV battery demand.
- Beyond 2040, while projections are speculative, if current trends continue as EV adoption is expected to become more widespread, nickel prices could potentially exceed \$30,000. Still, if alternative battery technologies gain prominence, prices might stabilize or grow at a slower rate than expected.



LME Nickel Price 2020-2024

Conclusion:

Throughout the 20 years of operation after commissioning, the nickel prices in the market are expected to remain well above **\$14,000**, which is the price assumption used for the financial analysis of the proposed project.

Project Summary

- **Project Name** : Nickel Atmospheric Acid Leaching Processing Plant
Project in Central Sulawesi, Indonesia
- **Developer** : PT. Industri Nikel Hidroksida (INH) and
PT. Burmi Persada Surya Pratama (BPSP)
- **Site Location** : Central Sulawesi Province, Indonesia
- **Project Site Area** : 12ha (2ha for facilities and 10ha for ore stockpile area)
 - Land clearing in progress
- **Accessibility** : Strategic location with connectivity
 - National road access
 - Jetty (10km)
 - Water source for operation from a river near the site
 - Airport (10km)
- **Laterite Ore Supply** : Approx. 214.000 ha with 135 registered IUP (100km)



Project Summary (Cont'd)

- **Production Capacity** : 4,000 MTPA (as Ni 99% Base) | $\pm$ 6,320 MTPA (as Ni (OH)₂)
 - By-products: MgO (69,487 MTPA) / Iron Oxide (85,187 MTPA) / Silica (127,260 MTPA)
 - **Input Capacity** : Laterite Nickel Ore (Ni $\pm$ 1.3%) 435,800 MTPA (Wet Feed Ore Base)
 - **Technology** : Atmospheric Acid Leaching (AAL) Process using Hydrochloric Acid (HCl)
 - **EPCC** : 32 Months (20 Months for Construction)
 - **Operation** : 20 Years
 - **Plant Unit Installed** : Integrated Nickel AAL Processing System
 - Raw Material Feeding System
 - Indirect Heating Rotary Kiln System
 - Purification System
 - Slurry Leaching & HCl Recovery System
- Package Equipment
 - Utility Facilities
 - Building & Support Facility



Indirect Heating Rotary Kiln System



Purification System

Summary of Key Features

- **Technology Name:** Nickel Atmospheric Acid Leaching (AAL) Process using Hydrochloric Acid (HCl)
- **Input Nickel Ore:** Laterite ($\text{Ni} \pm 1.3\%$)
- **Technical Features:**
 - Extraction of nickel using hydrochloric acid (HCl) at room temperature and pressure
 - HCl produced within the process by heating magnesium chloride (MgCl_2), which is recycled, ensuring economic viability, handling, and process safety
- **Advantages:**
 - Lower investment cost compared to High-Pressure Acid Leaching (HPAL) process (50% lower in TIC)
 - Lower energy consumption and emission
 - Safer, easier, and more stable and flexible operation
 - Production of high-value by-products (magnesium oxide, iron oxide, silica, etc.) maximizes the profits and reduces waste
 - Environmentally friendly and waste-free process with Zero-Liquid Discharge (ZLD) technology

Comparison of Nickel Extraction Process

Process	Smelting	HPAL (High Pressure Acid Leach)	AAL (Atmospheric Acid Leaching using HCl)
Raw Material	Sulfide ore	Laterite Ore	Laterite Ore
Technology	Production of ferronickel by smelting / reduction process	Nickel concentrates by acid leaching at high temp. (250~270 °C), high press. (40~50 bar)	Nickel concentration and other product from waste at atmospheric pressure and normal temp. (AMB~80 °C)
Process	Nickel ore → Drying → Preliminary reduction → Melting furnace (>1,500 °C) & Reduction → Separation of FeNi & Slag → Refining → Casting → FeNi	Nickel ore → Water mixing → Autoclave → Neutralization → Precipitation of sulfide metal → Autoclave → Solvent extraction → Autoclave (hydrogen reduction) → Ni powder	Nickel ore → Acid leaching → 1st purification → 2nd purification → Highly concentrated Ni, Nickel Hydroxide
CAPEX	400	200	100
Final Product	Fe-Ni	Ni metal	Nickel Hydroxide, Iron Oxide, SiO ₂ , MgO
Purity of final nickel related products	Fe-Ni: 20%	Nickel Metal: 99%	Nickel Hydroxide: > 90% Nickel Sulfate: 99.9%
Key Features	Initial TIC: Very high Operating Power: Very High Operation Steps: Simple By-Products: Low	Initial TIC: High Operating Power: High Operation Steps: Complicate By-Products: Low	Initial TIC: Low Operating Power: Low Operation Steps: Simple By-Products: High
Energy Consumption & Emissions	High	Middle	Low
Wastewater & Waste	Fe-Ni Slag (>90% of feed) & Many wastewater	Many acidic wastewater	Waste-free process. ZLD (Zero Liquid Discharge)

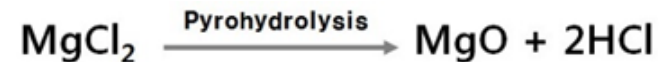
AAL Process Features in Comparison with HPAL

Atmospheric Acid Leaching using recycled Hydrochloric Acid process is superior to the HPAL process in terms of economy, safety, stability and flexibility of operation:

- **Cost Efficiency (Reduction of both CAPEX and OPEX)**
 - EPCC and O&M cost is much reduced. (e.g. The operational conditions of atmospheric pressure allow the use of FRP materials in the plant units while the HPAL methods necessitate titanium-coated material due to the high pressure involved.)
- **Operational Safety**
 - The HCl gas used for acid leaching is produced by Pyro-hydrolysis of MgCl_2 . The HCl gas is recycled in the process under the negative pressure condition, ensuring operational safety. The recovery of HCl gas is very high (>99%), which saves cost.
- **Operational Flexibility**
 - By appropriately separating the iron oxide from the mixed metal chloride solution of iron and nickel, crude ferro-nickel can be produced for use as a raw material in the smelting process.
- **High Value Added By-Products**
 - High-value added by-products are produced from the process waste, and all the water used in the process is recycled within the system, which is both economical and environment-friendly.

AAL Process Description

- Atmospheric Acid Leaching using recycled Hydrochloric Acid is a waste-free process that produces high-nickel recovery rates (> 99%) and high-value by-products from waste as well as safe operation with atmospheric pressure operation.
- The process consists of 5 steps: 1) Pyro-hydrolysis of Magnesium Chloride, 2) Acid Leaching, 3) Phase Separation, 4) Purification of Iron oxide, and 5) Purification of Nickel hydroxide.
- **STEP 1:** Pyro-hydrolysis of MgCl_2 produces MgO (particle) and HCl (gas) by an Indirect Heating Continuous Rotary Kiln System.



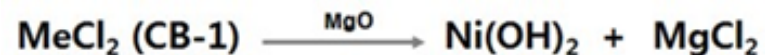
- The MgCl_2 required for HCl gas production is solid. After being put into the plant, it is dissolved in water and used as a MgCl_2 solution, ensuring ease of handling and safety. Additionally, the HCl gas generated from MgCl_2 is continuously circulated and reused. This results in a high recovery rate of HCl gas, and since the circulation process is in a negative pressure state, the risk of acid gas leakage is minimized, ensuring high operation safety. The Indirect Heating Rotary Kiln System, which can use various types of fuel such as gas, electricity, and coal, ensures there is no mixing with HCl gas with combustion gas.

AAL Process Description (Cont'd)

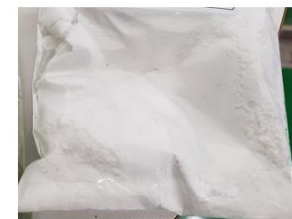
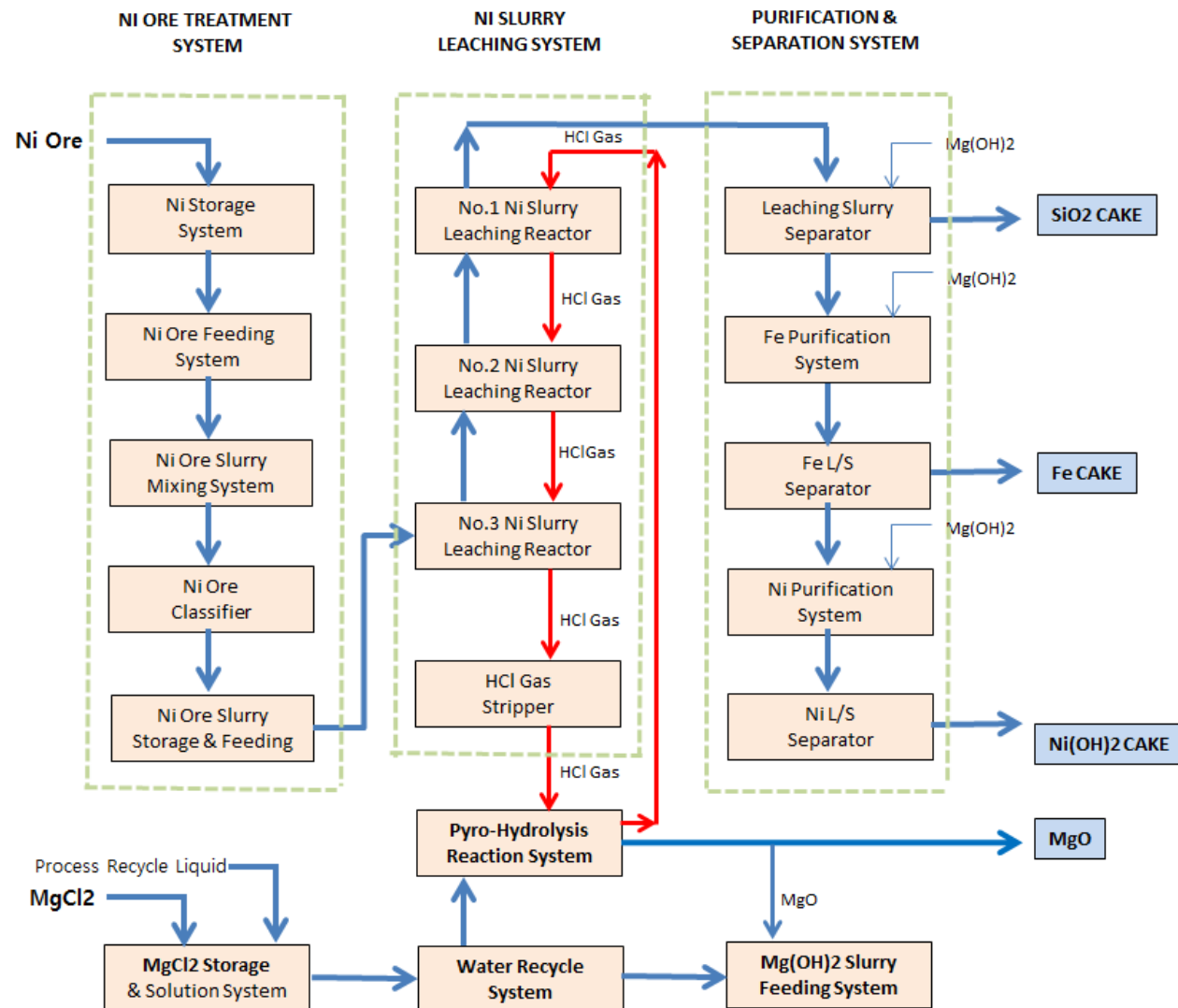
- **STEP 2:** Nickel ore is leached with HCl gas produced from Pyro-hydrolysis of MgCl_2 . The raw material, nickel ore, is first crushed into particles of 100 microns using a ball mill crusher. It is then mixed with water and introduced into a scrubber type acid leaching tower through a nickel ore feeder, forming a metal chloride solution.
- **STEP 3:** Purification of Si/Fe oxide process. Most of silica and 70~80% of iron oxide is separated from the metal chloride solution by pH control.
- **STEP 4:** Iron oxide is separated from the metal chloride solution after the STEP 4.



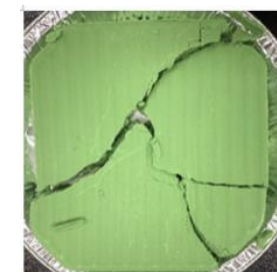
- **STEP 5:** Nickel hydroxide is separated from the metal chloride solution.



AAL Process Flow Chart



Silica

Fe₂O₃

Nickel Hydroxide (Wet)

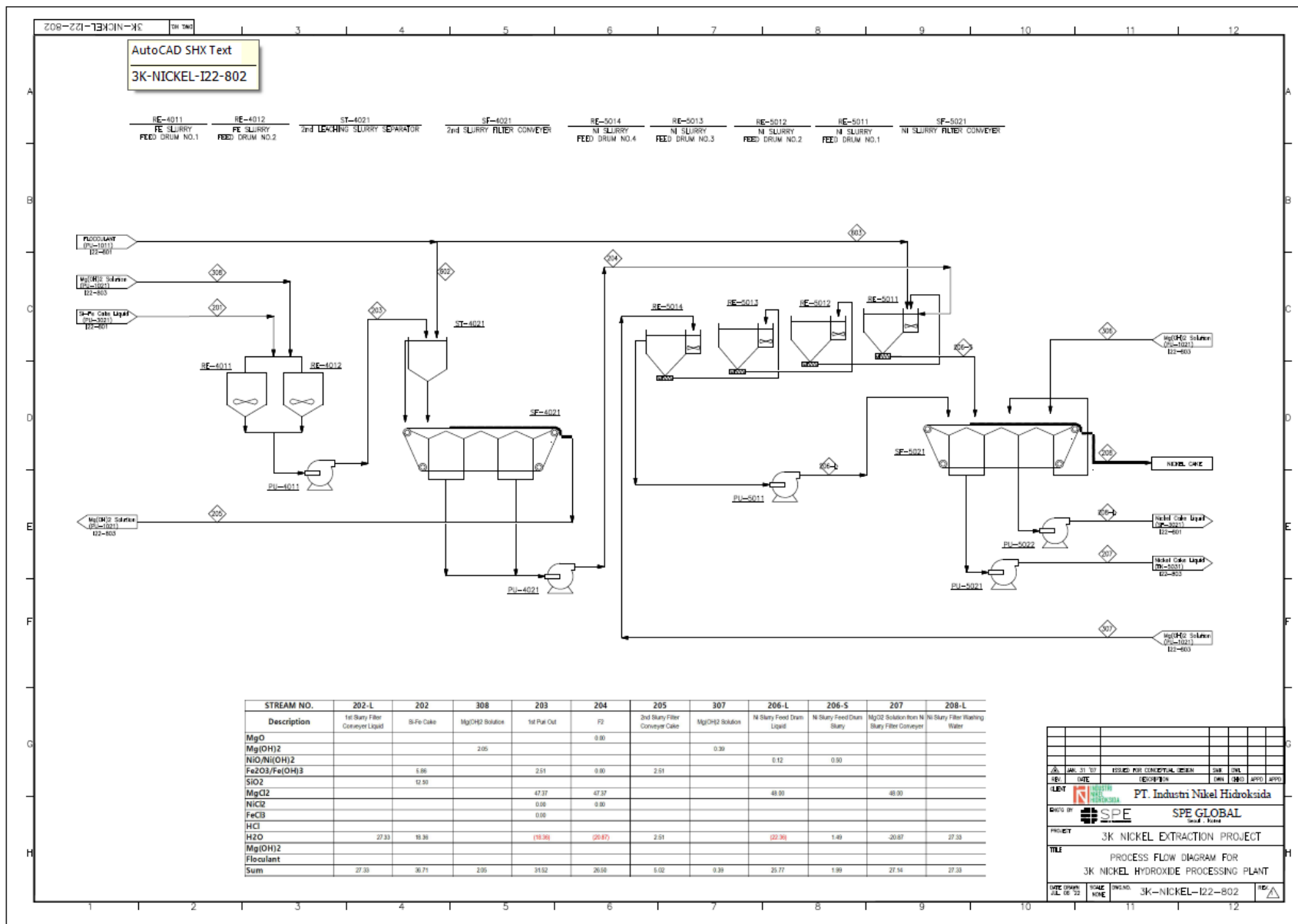


Nickel Hydroxide (Dry)

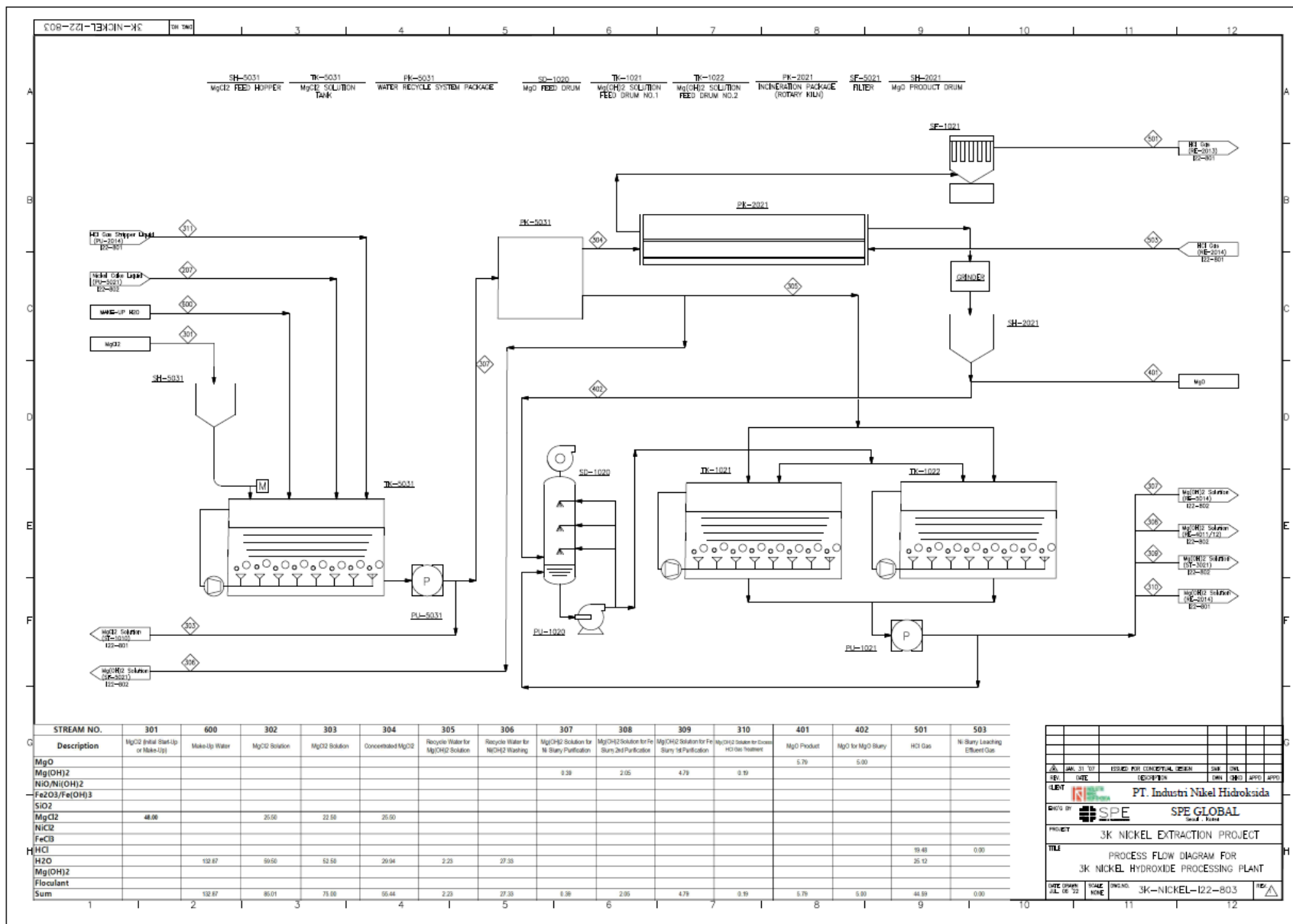


Magnesium Oxide

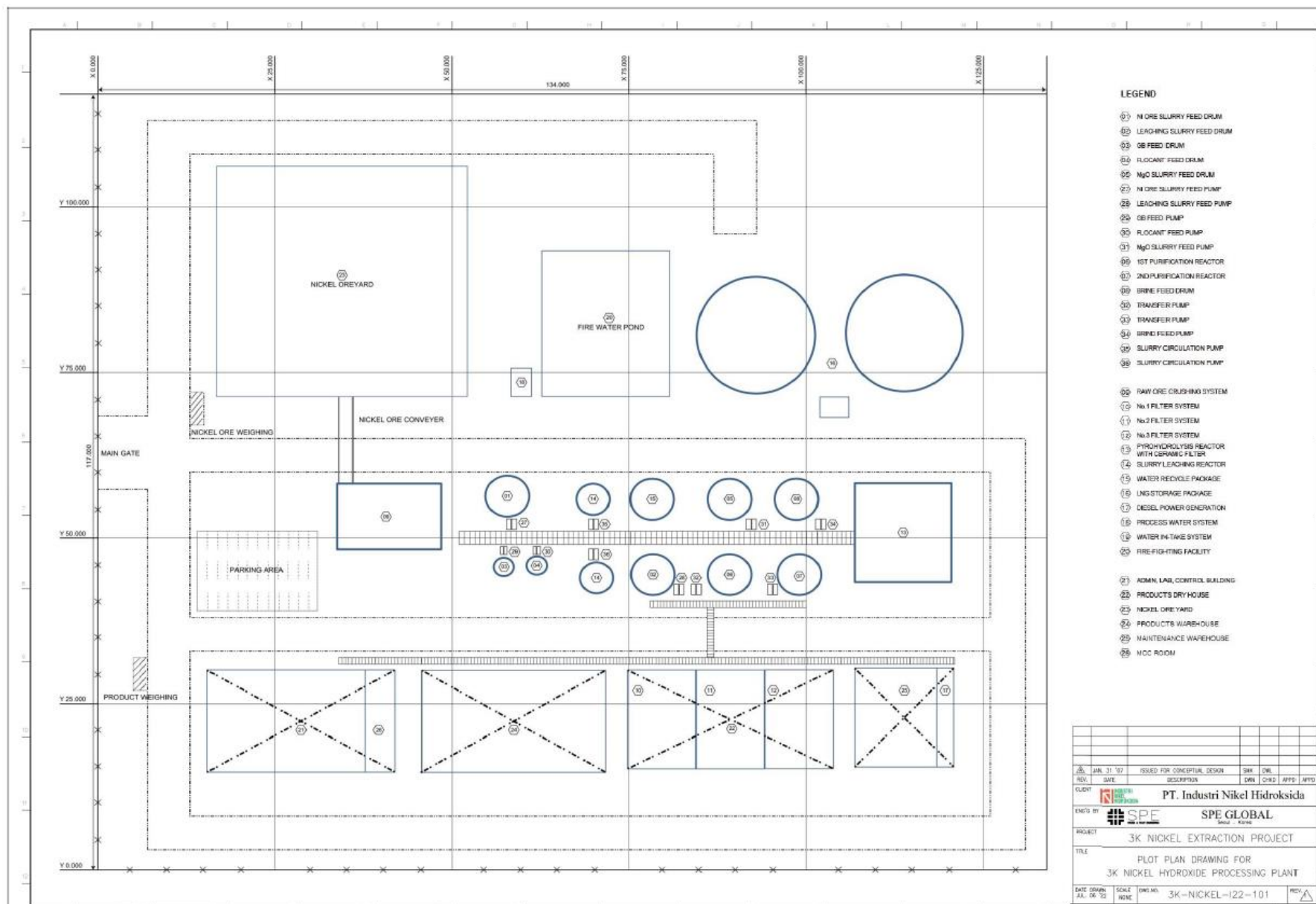
PFD2



PFD3



Plot Plan



Project Cost Estimation

ITEMS		COST [USD]
EPCC	Engineering	6,350,000
	Procurement	49,054,000
	Construction	23,896,000
	Commissioning	5,700,000
EPCC Total		85,000,000

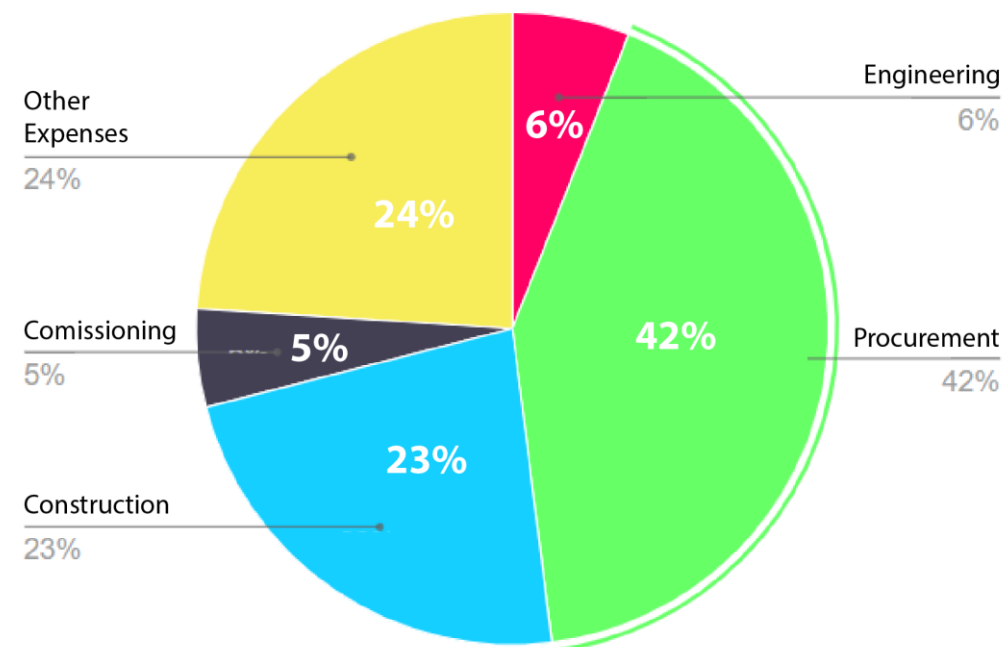
ITEMS		COST [USD]
Other Expenses	Government Permits & Licenses	450,000
	Plant Site Acquisition (If Required)	180,000
	Feasibility Study (Bankable)	500,000
	Permanent & Temporary Work by Owner Portion	8,870,000
	Working Capital	6,000,000
	IDC (2 years)	9,800,000
	Other Expenses Total	25,800,000

EPCC COST

85,000,000

TOTAL PROJECT COST

110,800,000



Cost Breakdown

Financial Analysis

ITEM	Capacity	Selling Price (USD)	Revenue (USD)
A. REVENUE			
1. Ni (Nickel Base)	4,000	14,000.00	56,000,000
2. MgO	69,487	750.00	52,115,000
3. SiO ₂	127,260	50.00	6,363,000
4. Fe ₂ O ₃	85,147	100.00	8,514,000
REVENUE			122,992,000

ITEM	Unit Cost (USD) /Ni Ore Ton	Cost (USD)
B. OPEX		
1. Ni Ore	28	12,202,000
2. Utility (Electricity & Fuel)	13.2	9,548,000
3. MgCl ₂ Cost	30.73	13,392,000
4. Labor	8.17	3,560,000
5. Maintenance & Repair	5.45	2,375,000
6. O&M Service	3.53	1,538,000
7. Phase Separator & Chemicals	4.38	1,908,000
EXPENDITURE		44,525,000

Financial Analysis based on 20 years operation with assumption of Revenue | OPEX annually and consider more facts such as Corporate Tax (25%), discount rate (7%), CR Premium (2.8%), Inflation (2%), WACC (5.2%), etc., with the following conclusion:

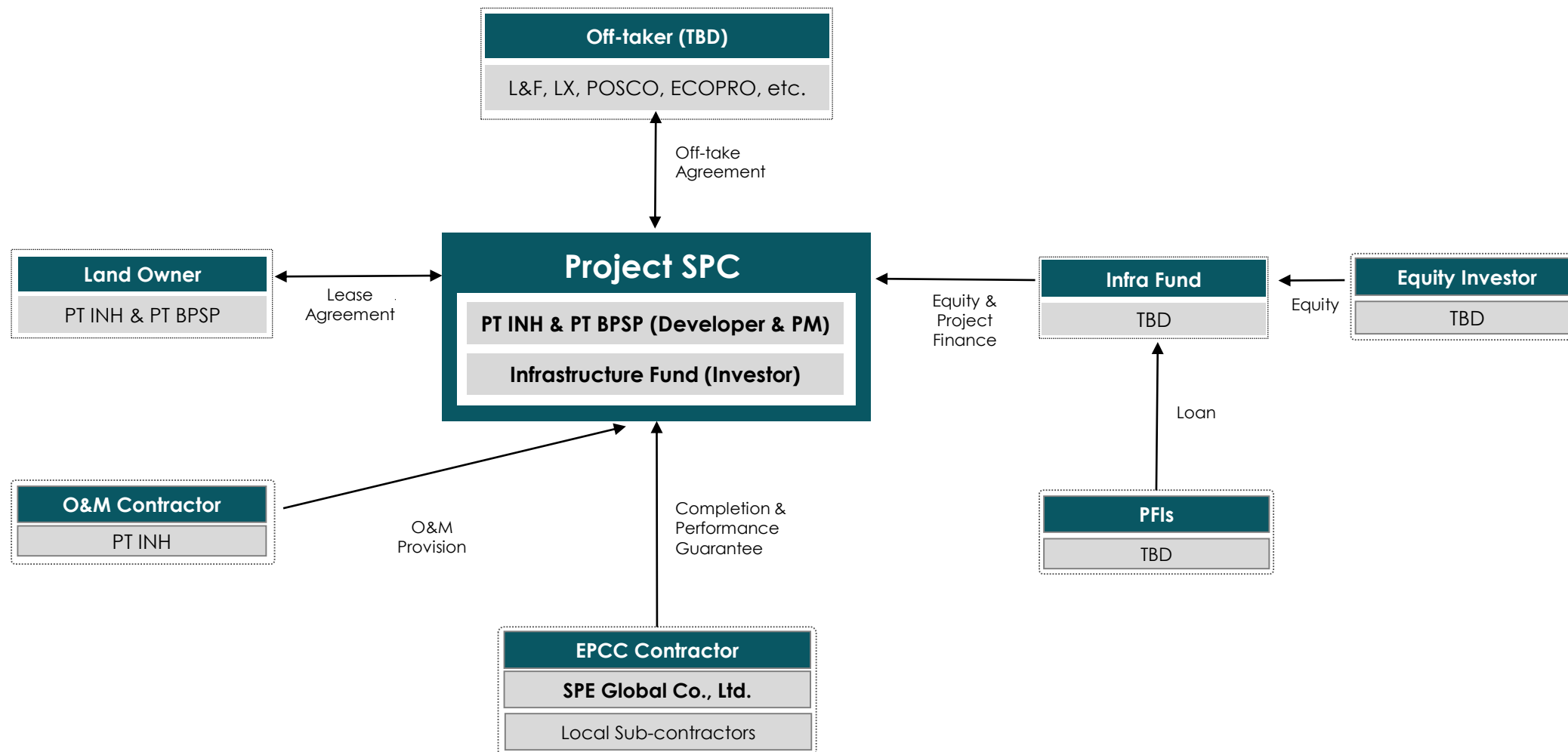
- Average EBITDA USD 82,890,000
- Adjusted NPV USD 381,640,000
- Project IRR (FCFF) **43.87%**

Sensitivity Test

CASES	FCFF IRR	Avg. EBITDA (MMUSD)	Adj. NPV (MMUSD)
Base Case	43.87%	82.89	381.64
Increase Capital Cost			
by 30%	35.79%	82.89	345.97
by 10%	40.79%	82.89	360.20
Decrease Capital Cost			
by 10%	47.47%	82.89	374.42
Feedstock Price			
up by 20%	42.81%	80.32	353.37
down by 10%	44.40%	84.18	374.18
Product Price (Ni)			
up by 10%	46.22%	88.81	398.68
down by 10%	41.45%	76.98	335.94
down by 20%	38.94%	71.06	304.56
Operating Expenses			
increase by 10%	42.46%	79.48	349.12
Eliminating Inflation Factor	42.50%	68.23	356.89

Ni Content (WT, %)	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
FCFF IRR (%)	38.25	40.11	42.02	43.87	45.69	47.46	49.20	50.89	52.55	54.18	55.77

Project Structure



Major Stakeholders

PT. INH & PT. BPSP are the developers and PM for the project. As prominent energy companies, we possess extensive field experience in mineral mining and sales, PM, CM, and O&M for energy infrastructure projects. We also have expertise in various permits and operational capabilities in Indonesia.

- **PT. INH** leads the FS, DD, nickel-ore supply, off-take arrangements, financial arrangements, EPCC, and O&M for the project.
- **PT. BPSP** is responsible for local permits, approvals, and licenses for development, construction, and commissioning of the project.

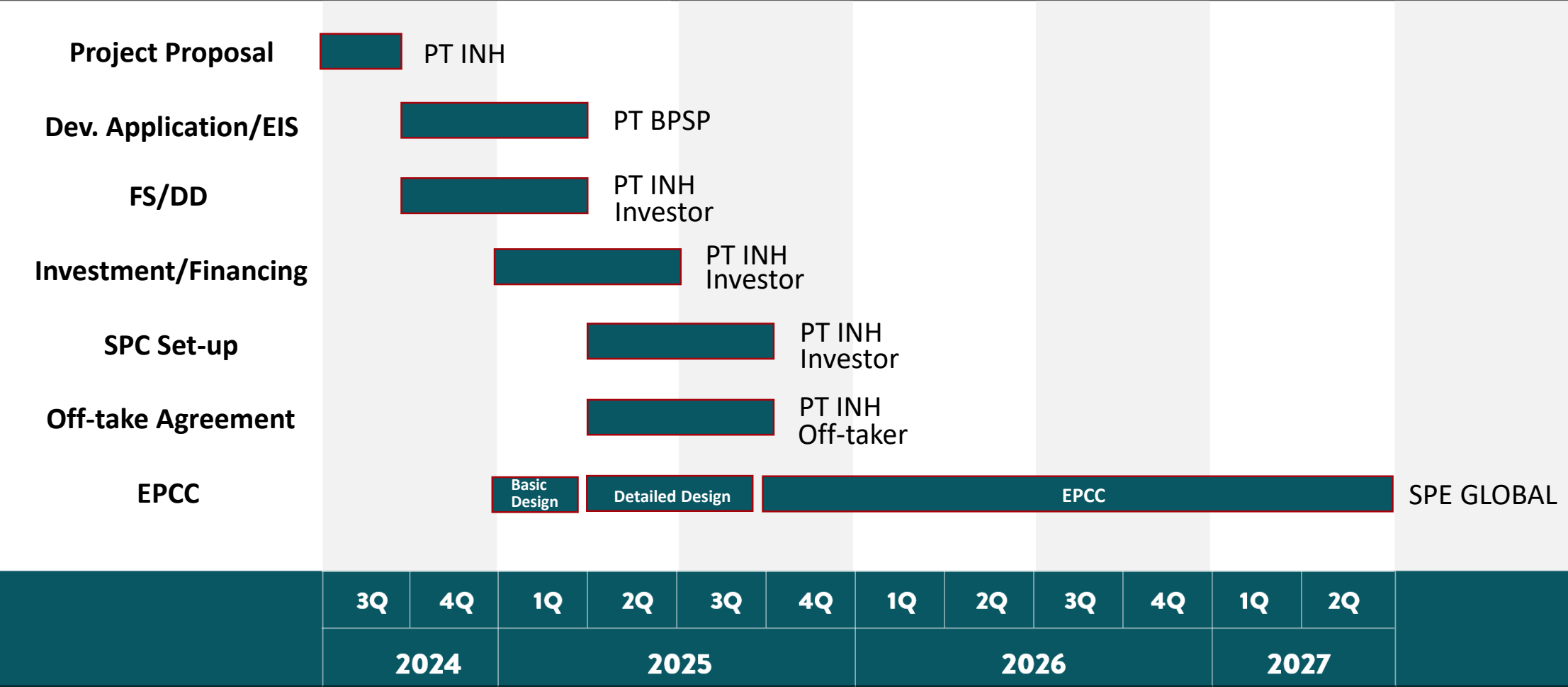
Local nickel hydrometallurgy plants in Indonesia have faced serious production quality issues due to deficiencies in robust designs, skills, and expertise. We intend to solve these challenges with the involvement of a reputable and reliable Korean EPCC company. **SPE Global Co. Ltd.**, as the proposed EPCC contractor, possesses verified capabilities in chemical plant design, construction, and operation.

Currently, several equity investors (SIs/FIs/OIs), as well as PFIs, have shown interests for the Project, both in Indonesia and overseas. The terms and conditions of investment and financing will be negotiated in detail.

Additionally, interest in off-take agreements have been identified with prominent NCM battery manufacturers in Korea, Japan, Canada, U.S.A., etc.

Project Timeline

The entire project period is proposed to be approximately 32 months. It is estimated that it will take 20 months from the start of construction to the commissioning of the Nickel AAL Processing Plant. Currently, part of development application and EIS has been processed, and the land clearing has been completed. Initial interests for off-take agreements, investment, and financing have been confirmed with potential participants of the project. The whole project schedule and lead time are as follows:



PT INH

We specialize in planning, development, implementation, and management of international energy infrastructure projects, delivering solutions with effective investment and financing strategies.

**Global Market Entry Strategy**

INDONESIA
ASEAN
Middle East
Australia

**Strategic Investment & Advisory**

Strategic Investment
Investment Advisory

**Strategic Project Development**

Nickel AAL Processing Plant
Waste to Energy (W2E) Plant
Green Hydrogen Plant
Solar Farm
ESS

**Project Management (PM)**

Energy Infrastructure Projects
RE100 Projects
W2E Projects
Real-estate/Logistics Projects

**ENERGY
INFRASTRUCTURE**

CORE CAPABILITIES AND EXPERTISE



Feasibility Studies

- Legal & administrative
- Physical & environmental
- Technical
- Financial
- Market



Project Structuring & Management

- Selection & management of participants
- Plan project execution & management
- Review of risks factors & hedging
- Execute & manage project schedule up to commissioning



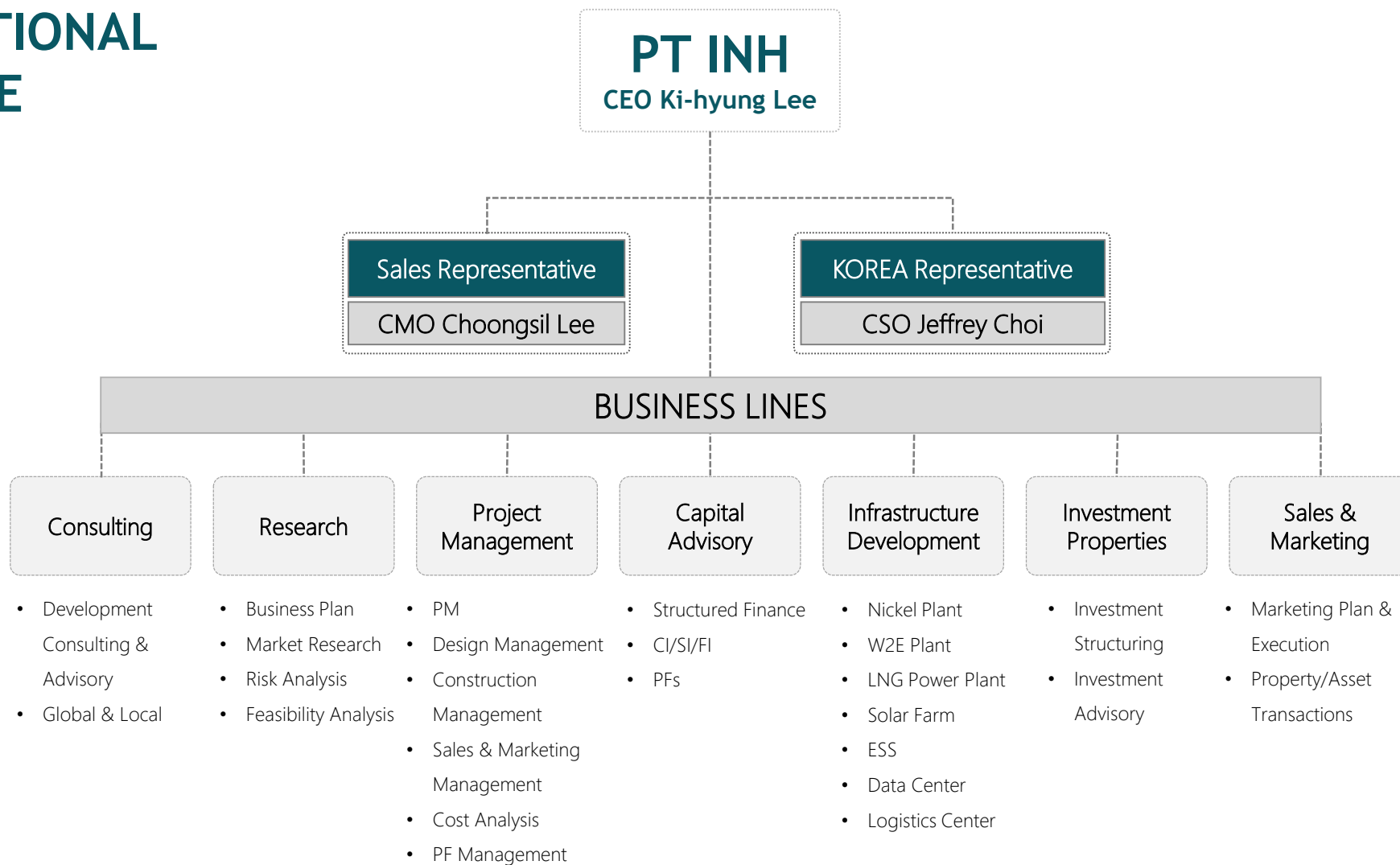
Project Development & Planning

- Analysis on market trends & conditions
- Analysis on business environments
- Legal FS
- Financial FS



Finance Structuring

- Funding planning
- Financial feasibility analysis
- Financial terms negotiation
- Review & management of business & loan agreements
- Management of capital according to the funding plan

ORGANIZATIONAL
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SPE Global Co., Ltd.

As a specialized EPCC company in the field of Oil & Gas Plants, Petrochemical Plants, Chemical Plants, Power Plants, as well as Green Energy Plants, we offer top-notch EPCC services backed by decades of the field experience and expertise.



Engineering

Basic/Detail/Front-End
Process/Mechanical
Piping/Instrumentation/Electrical
Civil/Structural



Procurement & Inspection

Vendors Qualification
Quotation
Technical Evaluation
Expediting/Inspection

EPCC



Construction & Commissioning

Construction Management
Commissioning
Start-up Operation
O&M
Revamp & Modification



Technical Support

Specialist & Engineer Support
Construction/Operation Supervisor
Technical Consultation
Safety/Risk/HAZOP Assessment



CORE CAPABILITIES AND EXPERTISE



Total System Engineering Process

- Reliable Engineering & Procurement services
- Expertise on Procurement Control, Construction Supervision, Pre-Commissioning, Commissioning & Operation
- BDP (Basic Design Package) & FEED (Front-End Engineering Design)
- Package for Offsite & Utility System
- SmartPlant P&ID / 3D modeling
- HSE & QA/QC Management System



Specialties and Experiences in Plants

- Experiences in various types of Plant System
- Experiences and Know-How in construction
- Modular Engineering and Modular Fabrication
- Basic & Detailed Design Engineering Services



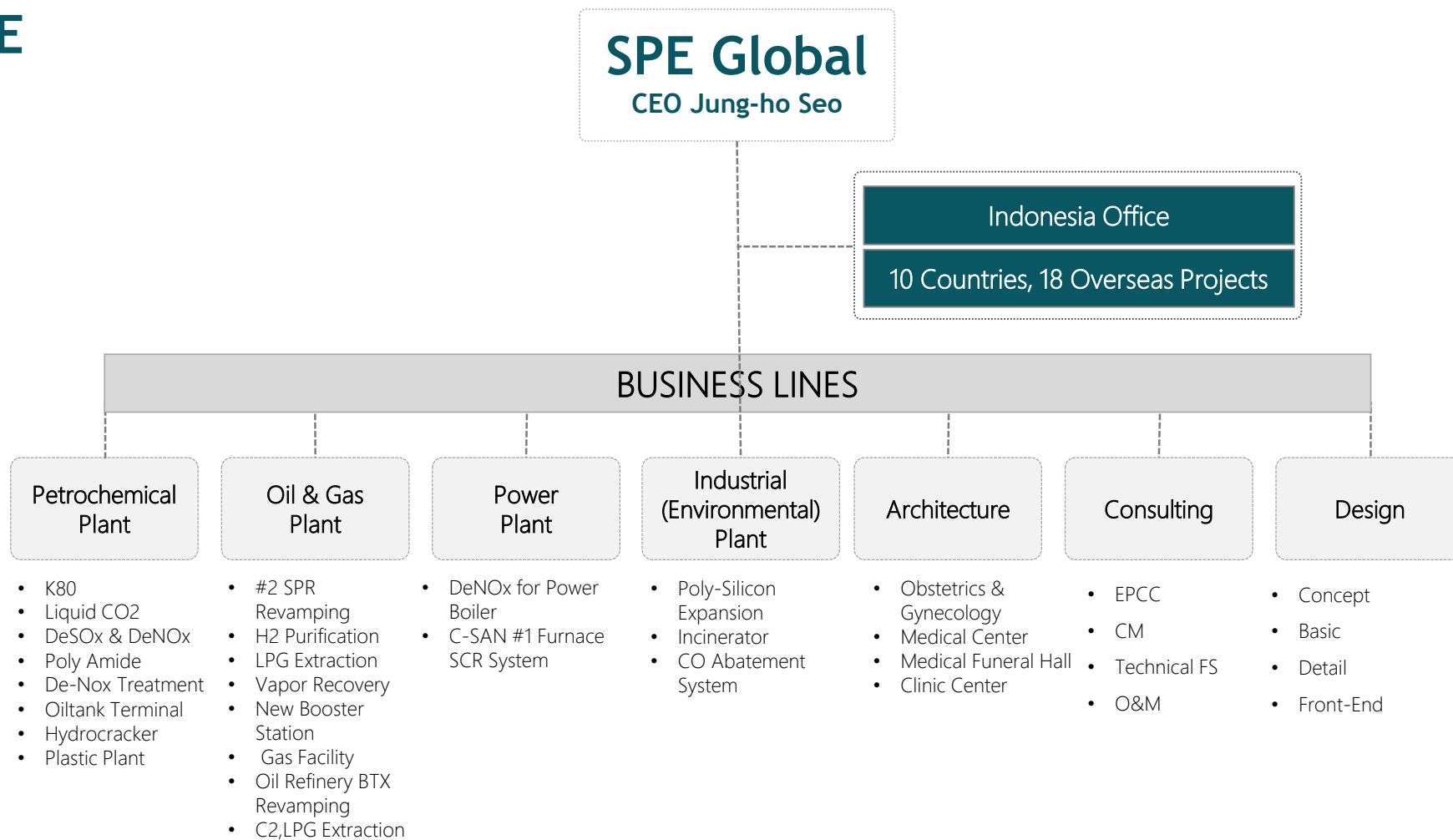
Optimal Design w/ ICT solutions

- Fast Track Schedule
- Indexes files on local and remote computer
- Rapid access to files through flexible querying
- EADDI (Engineering Application Design Data Integration) System
- SmartPlant P&ID
- 3D CAD



HSE(Health, Safety, Environment) Management

- Monitoring, Measurement, Records, Audit
- Risk Assessment and Management
- Consultation and Communication
- Operational Control and Reponse

ORGANIZATIONAL
STRUCTURE

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Point of Contact:

Jeffrey Choi
CSO, PT INH
jchoi95@gmail.com

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"Luceat Lux Vestra" Mt. 5:16

