BRASS

1st International Seminar

on Design and Operation of Long-Distance Transportation Pipeline Systems

26th & 27th September 2024

BRASS

Pipeline Commissioning

Pipeline Commissioning

Pipeline Commissioning

- What is Commissioning?
- Why Commissioning is Important?
- What are the Commissioning Phases?
- Why Commissioning with BRASS?
- BRASS Commissioning cases

What is Commissioning?

What is Commissioning?

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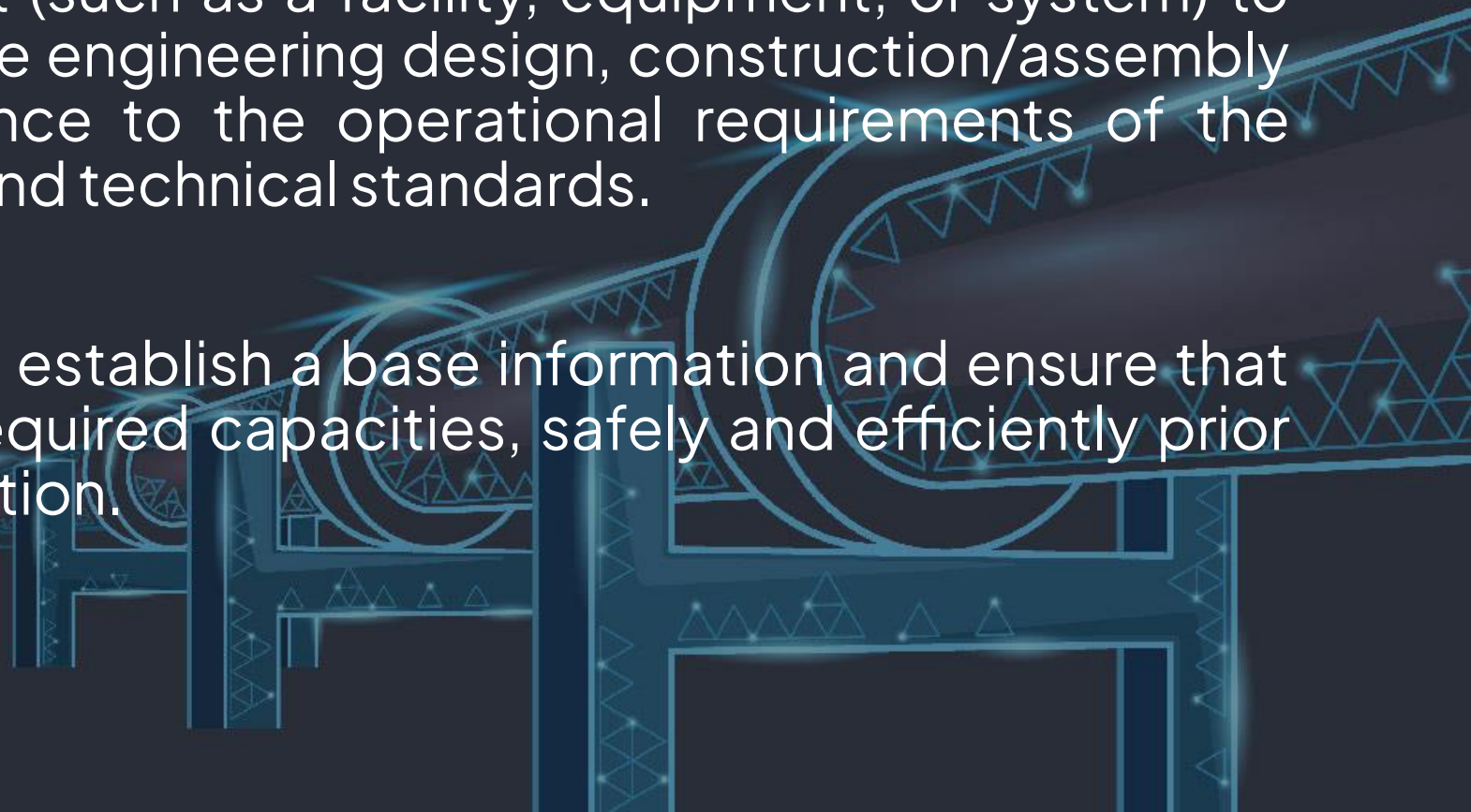
- Asset commissioning is the process of testing all systems and components of an asset (such as a facility, equipment, or system) to ensure compliance of the engineering design, construction/assembly and testing in accordance to the operational requirements of the owner/client, suppliers and technical standards.

- This process is crucial to establish a base information and ensure that the system meets the required capacities, safely and efficiently prior to the commercial operation.



Why Commissioning is Important?

Why commissioning is important?

Operational Efficiency:

- Proper commissioning ensures that all systems are optimized, minimizing failures and interruptions during operation.

Safety:

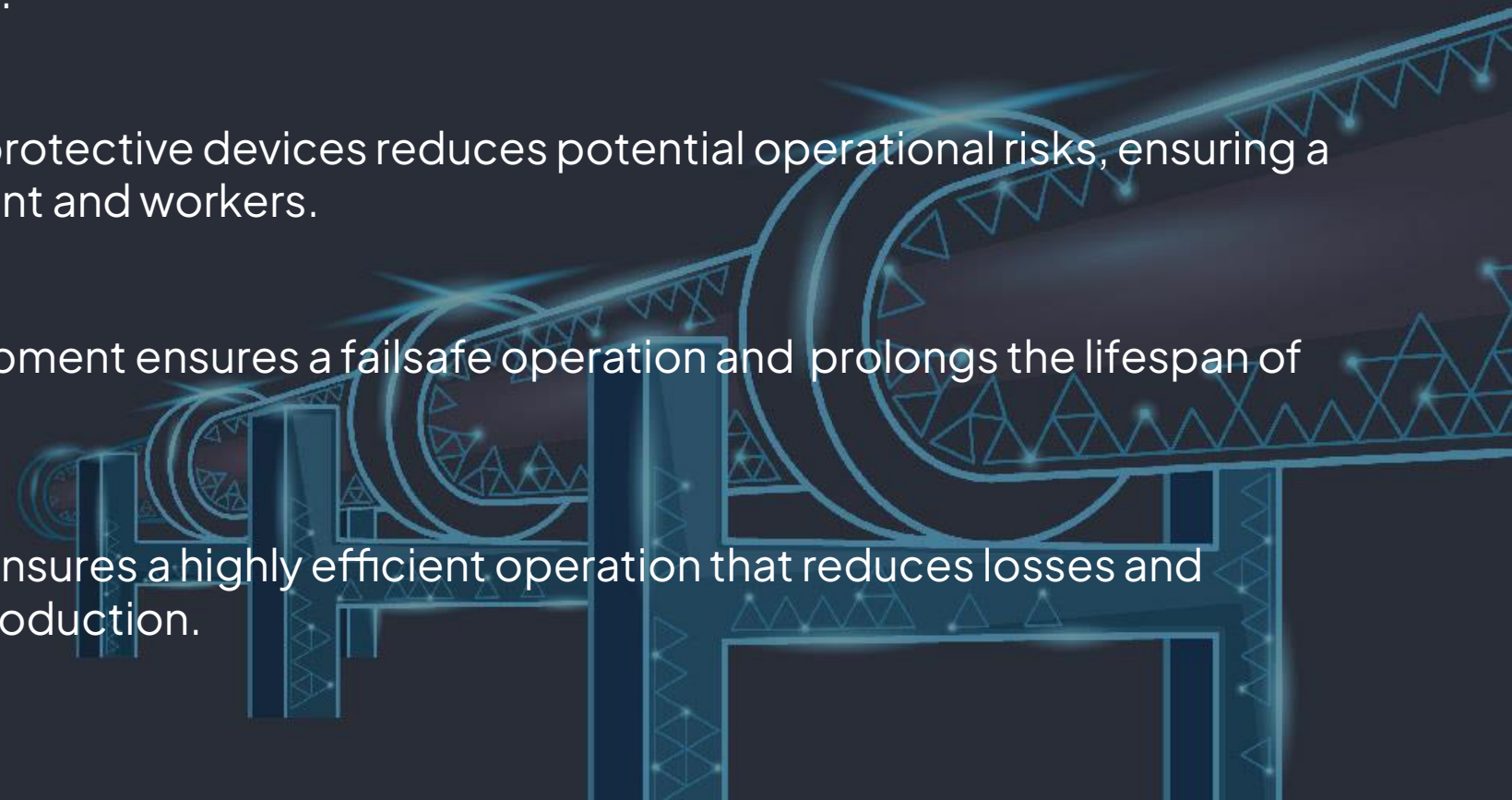
- Verification of interlocks and protective devices reduces potential operational risks, ensuring a safe environment for equipment and workers.

Reliability:

- Endurance testing of the equipment ensures a failsafe operation and prolongs the lifespan of the pipeline system.

Resource Savings:

- Optimizing controls settings ensures a highly efficient operation that reduces losses and wastage during large-scale production.



Why commission your asset?

Ensure equipment functionality.

- Equipment alignment
- Vibration Testing
- Gear Box Temperature Testing
- Ensures functionality of bearings, shafts and motor-pump couplings

Why commission your asset?

Identify assembly failures that impact asset performance.

- Inverted restriction orifice assembly
- Cracked ceramic chokes during assembly
- Verification of correct choke diameters and arrangement.

Why commission your asset?

Analyzing operation results

- LDS visualization
- Adjust operational parameters

What are the Commissioning Phases?

What Are the Commissioning Phases?

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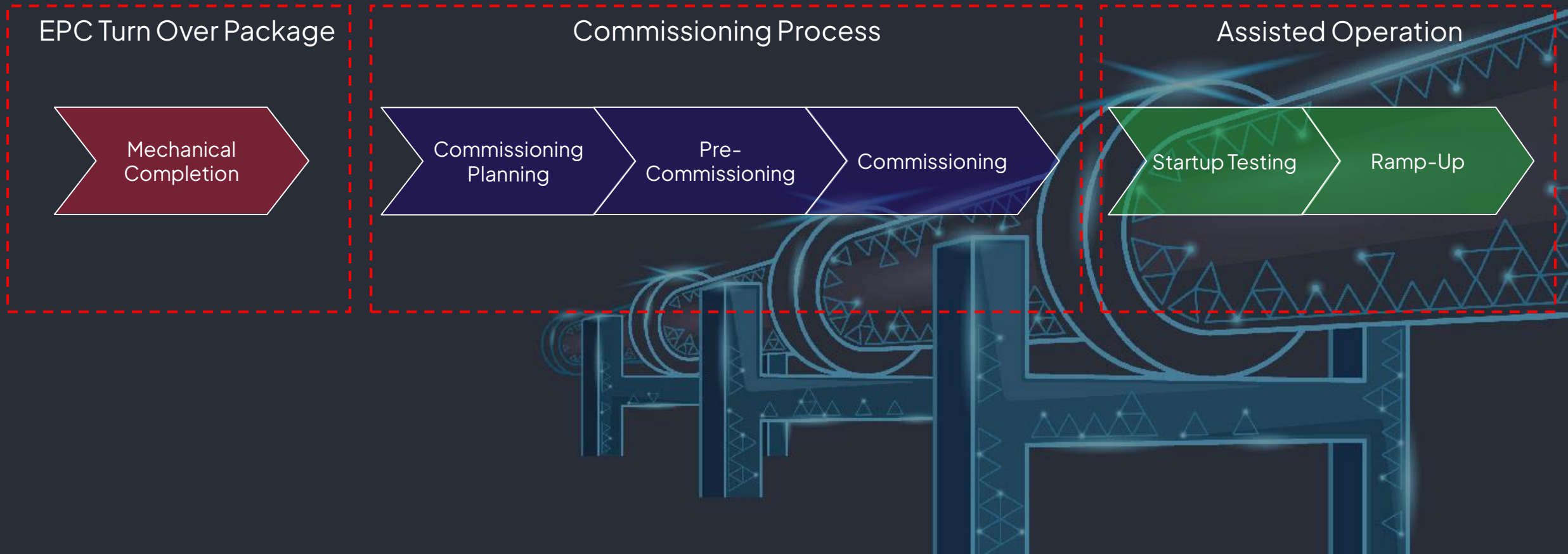

What Are the Commissioning Phases?

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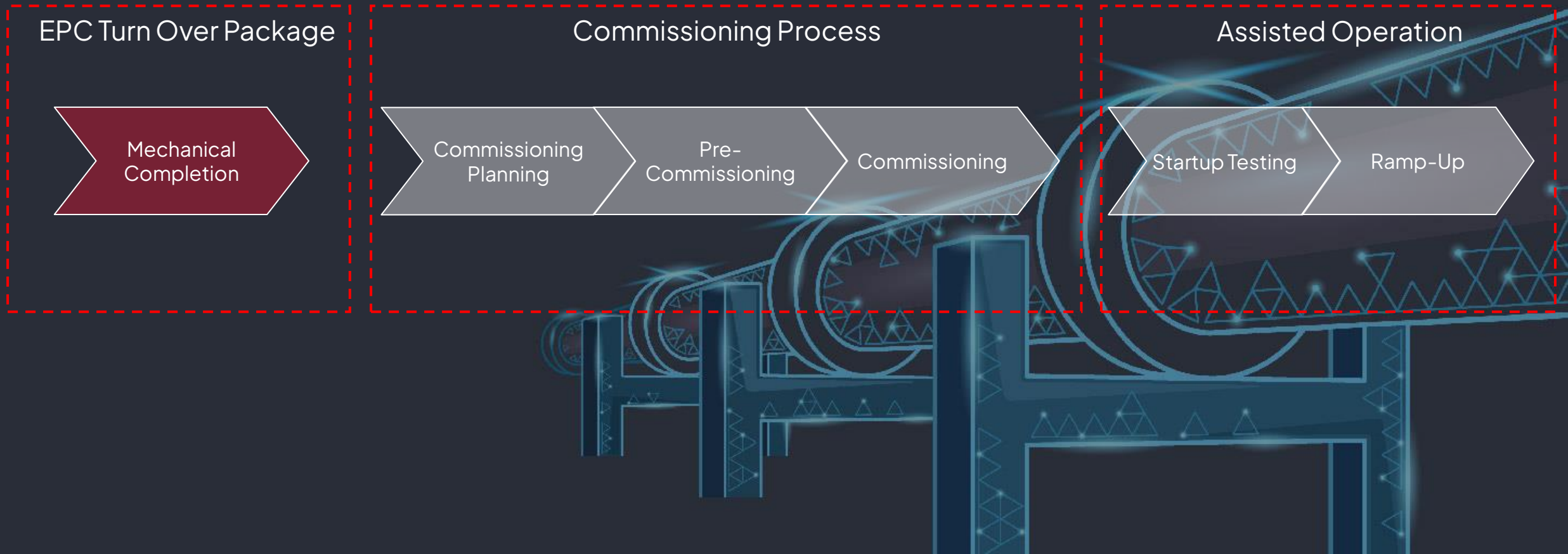


Mechanical Completion

Confirmation of the correct assembly of the installations according to the project, specifications, and applicable standards:

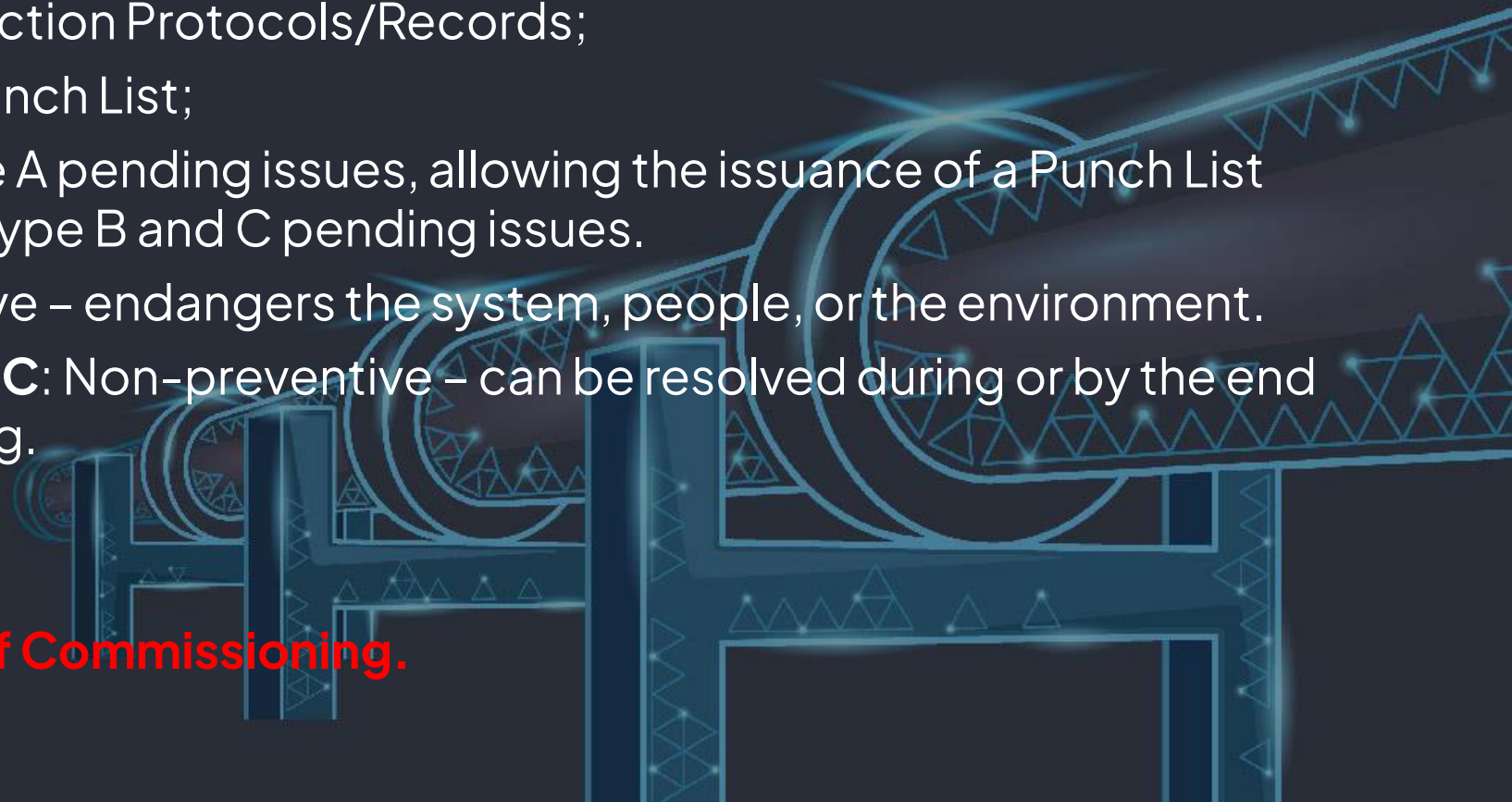
- Visual Inspection
- Hydrostatic Test
- Continuity Test
- Insulation Test
- Equipment Lubrication
- Line Cleaning
- Alignment
- No-load tests

These are NOT IN SCOPE of Commissioning.

Mechanical Completion

The EPC team will perform the validation of the mechanical completion protocols, and the results are presented in a report.

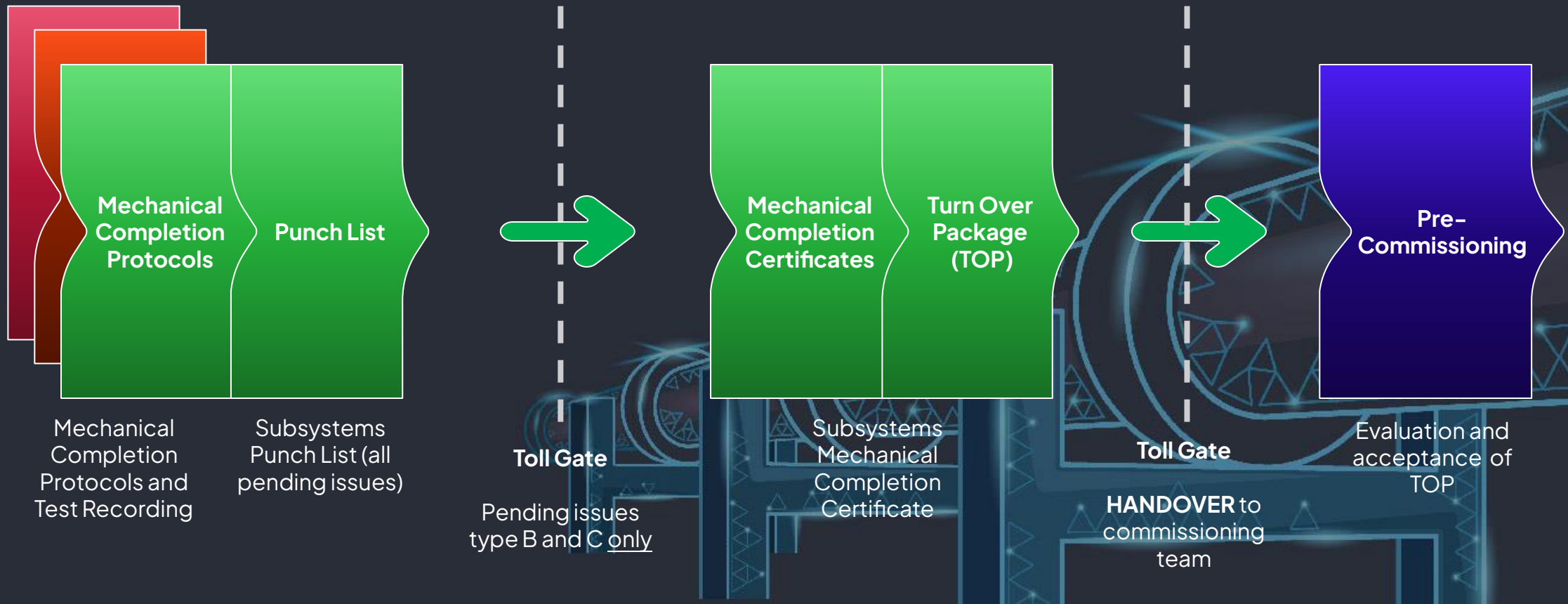
- Completion of Inspection Protocols/Records;
- Elaboration of the Punch List;
- Resolution of all Type A pending issues, allowing the issuance of a Punch List only with remaining Type B and C pending issues.
  - **Type A**: Preventive – endangers the system, people, or the environment.
  - **Type B and Type C**: Non-preventive – can be resolved during or by the end of commissioning.



These are NOT IN SCOPE of Commissioning.

Mechanical Completion

Custody Transfer Assembler/EPC to Commissioning:



What Are the Commissioning Phases?

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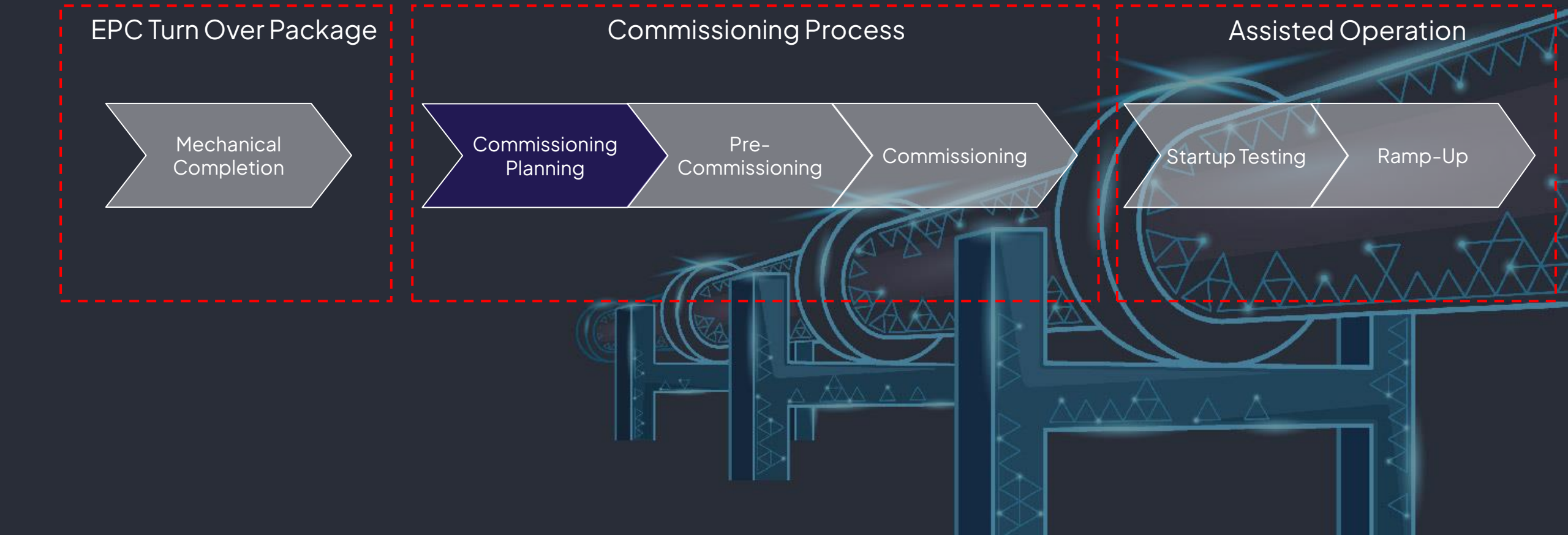
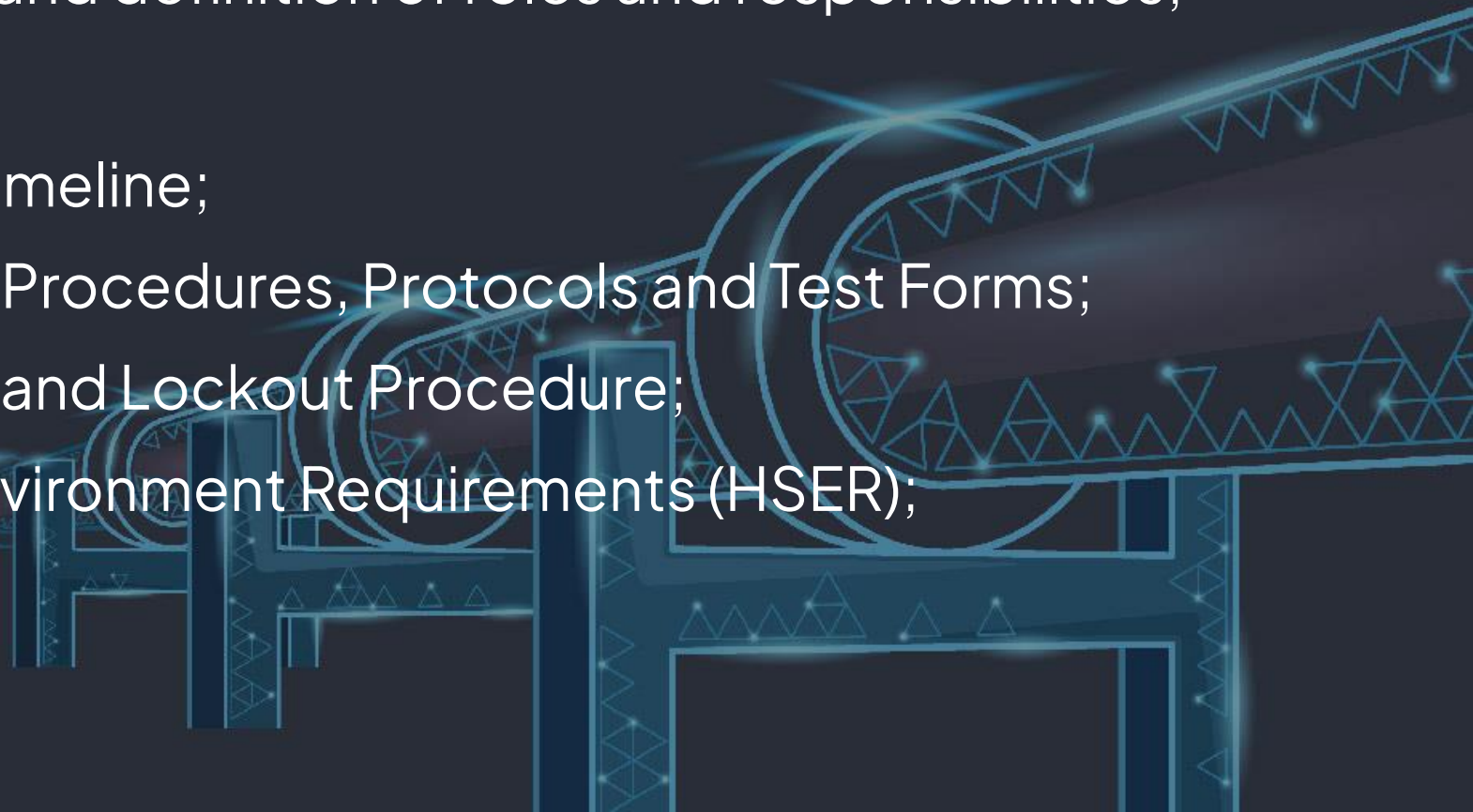


Commissioning Planning

Main Activities (minimal requirements)

- Formation of groups and definition of roles and responsibilities;
- Organizational chart;
- Activity schedule or timeline;
- Development of Test Procedures, Protocols and Test Forms;
- Communication Plan and Lockout Procedure;
- Health, Safety and Environment Requirements (HSER);
- Others



Commissioning Planning

Commissioning Requirements (examples)

- Communication Plan
- Rules Applied to the worksite

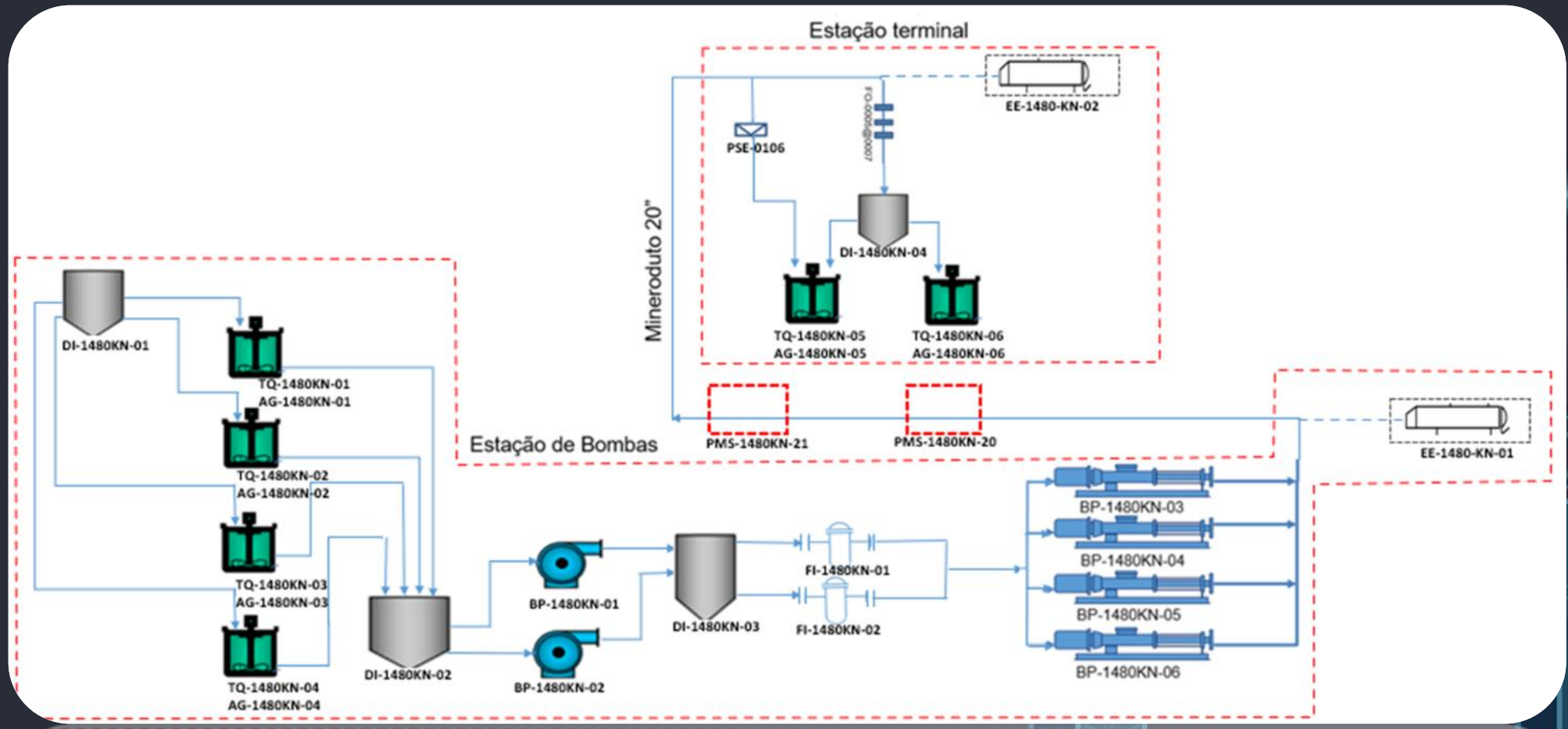
Commissioning Planning

Commissioning Requirements (examples)

- Guidelines for tagging and blocking

Commissioning Planning

Asset Separation in Systems and Subsystems



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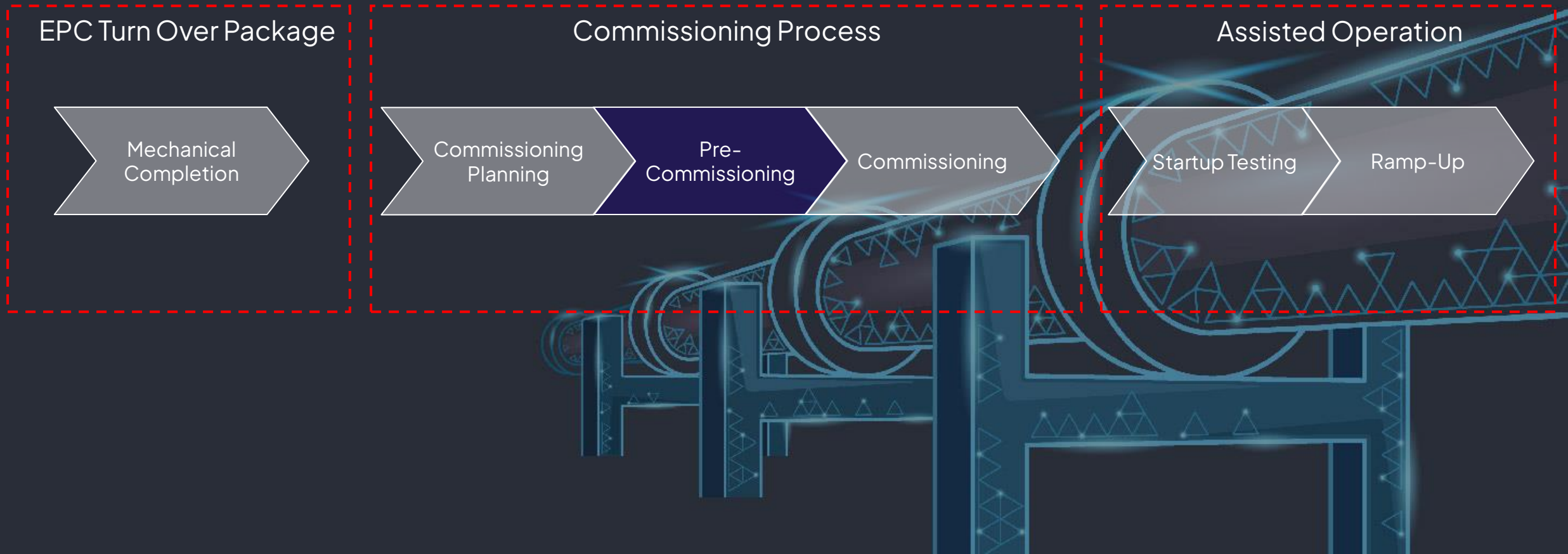
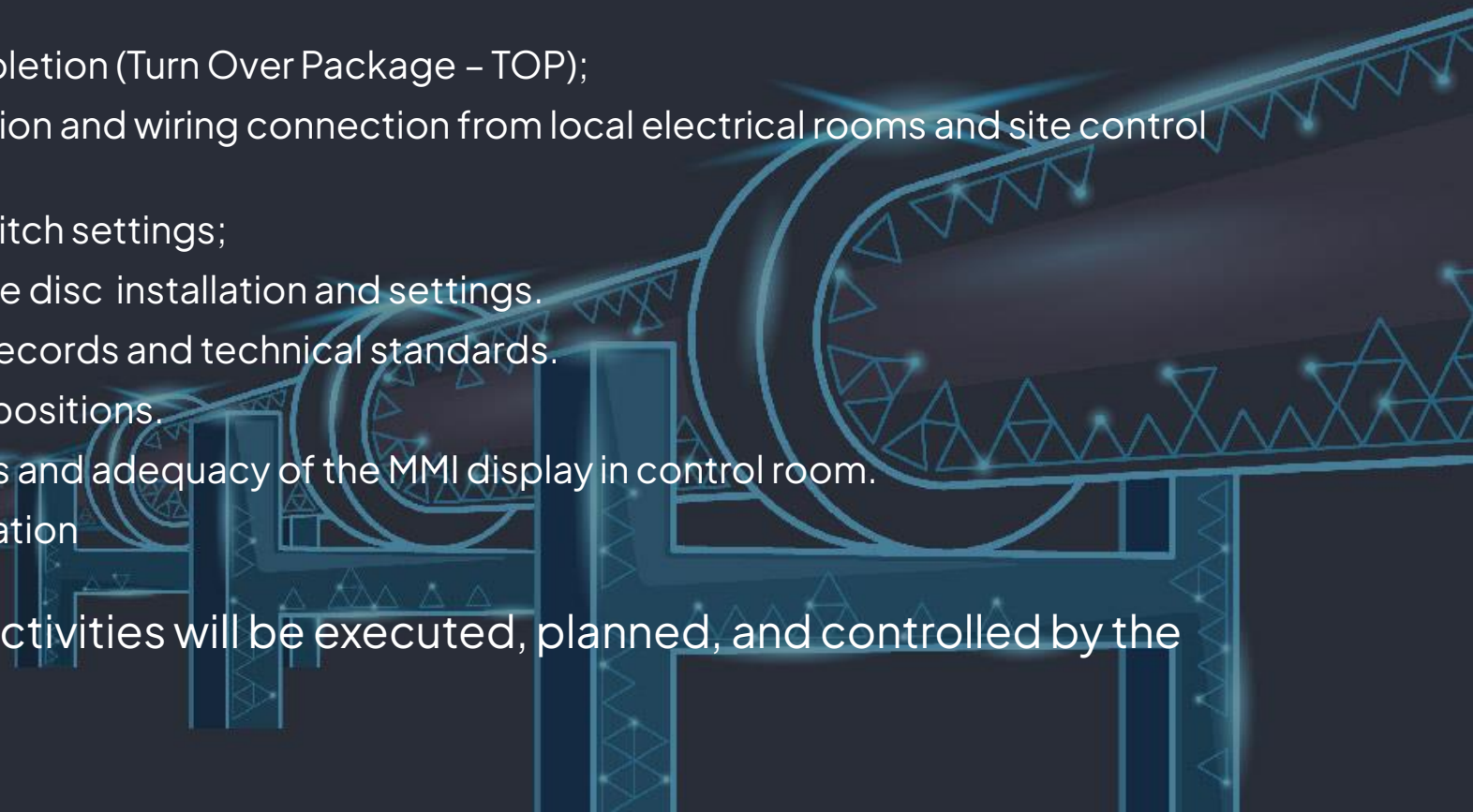


Pre-Commissioning

Also known as **Cold Functional Testing** - Ensure that equipment is properly installed and ready to begin commissioning with load;

- Verification of Mechanical Completion (Turn Over Package – TOP);
- Verification of field instrumentation and wiring connection from local electrical rooms and site control room signal verification
- Manual Valve Stroke and limit switch settings;
- Verification of relief valve/rupture disc installation and settings.
- Verification of Hydrostatic test records and technical standards.
- Verification of Valve and Choke positions.
- Verification of the completeness and adequacy of the MMI display in control room.
- Verification of equipment calibration

The pre-commissioning tests and activities will be executed, planned, and controlled by the commissioning team



Pre-Commissioning

Ensure Quality

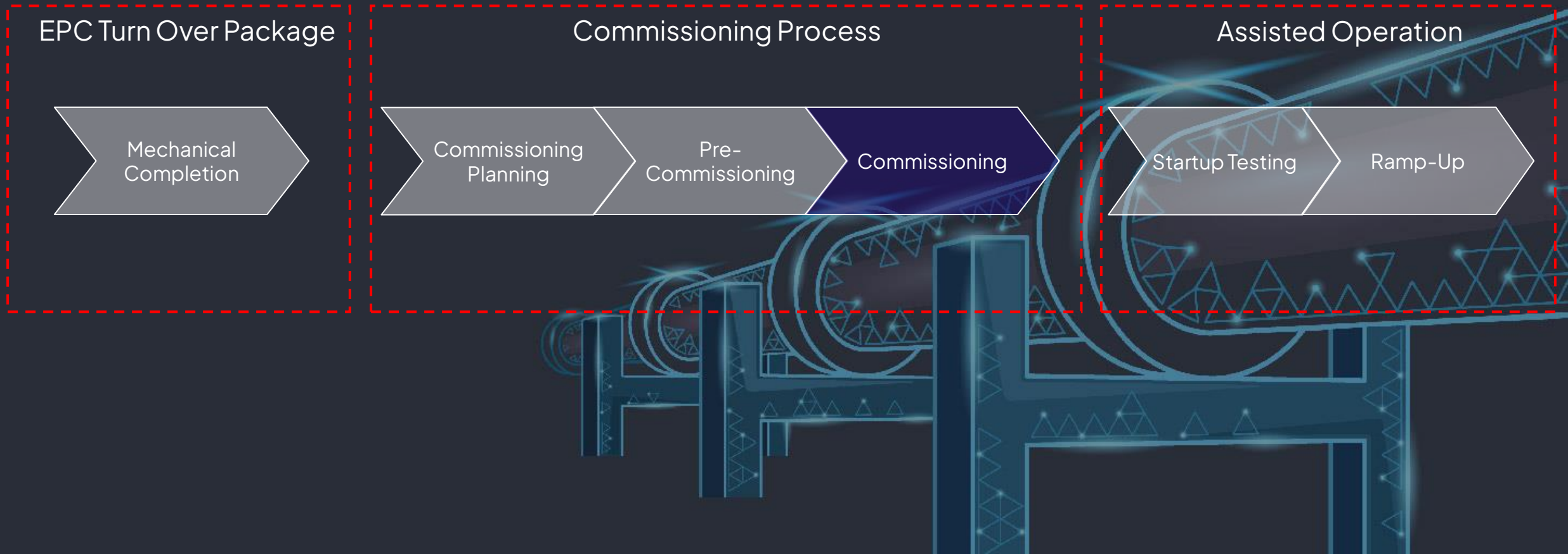
- Step-by-Step inspection
- Evaluation of cathodic protection along the pipeline

Pre-Commissioning

Ensure Quality

- Valve movement testing (manual mode)
- Limit Switch Settings

What Are the Commissioning Phases?



Commissioning

Also known as **Hot Functional Testing** – Dynamic Verification of the asset (all subsystems)

- **Load Tests Part 1, on Water:**
  - Pipeline filling and pigging
  - Pressure Test (Static & Dynamic)
  - Flow Capacity Testing on Water
  - Pump Curve and Capacity Verification
  - Choke Verification
  - Remote/Local Instrumentation and Controls Interlock verification
  - Shutdown and Restart Sequence verification
  - Establish baseline information for pipeline roughness
  - Vibration tests

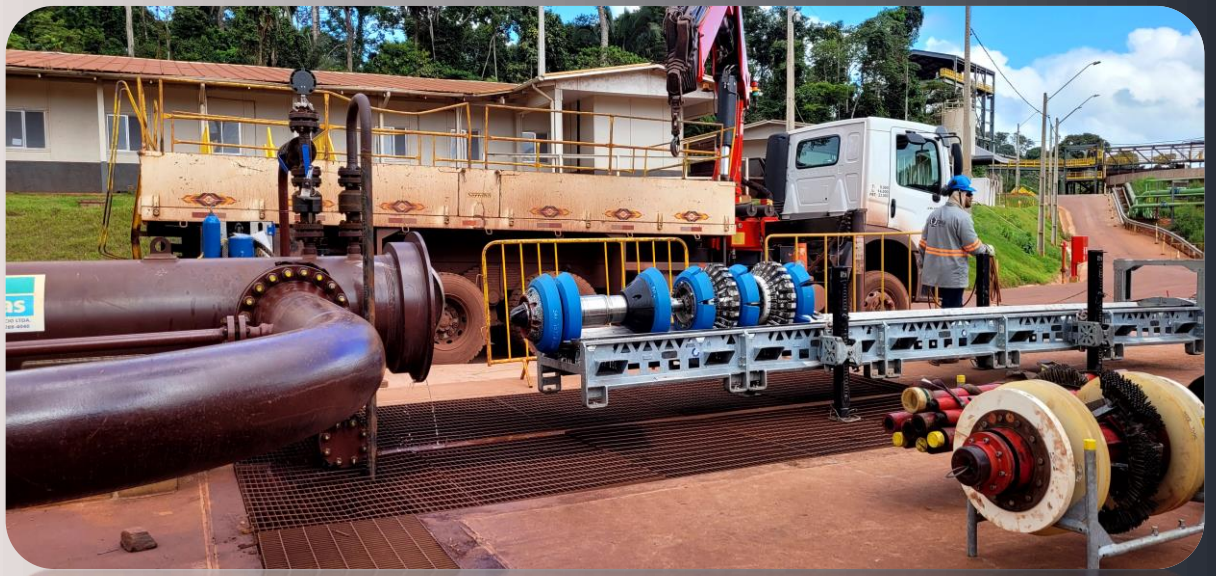
The execution of commissioning subsystem tests will be carried out by the commissioning team with support from the suppliers themselves.

Commissioning

System analysis (Water)

- Motor vibration tests
- Centrifugal charge pump

Commissioning



Ensure Quality

- PIG run to ensure pipeline is free from air

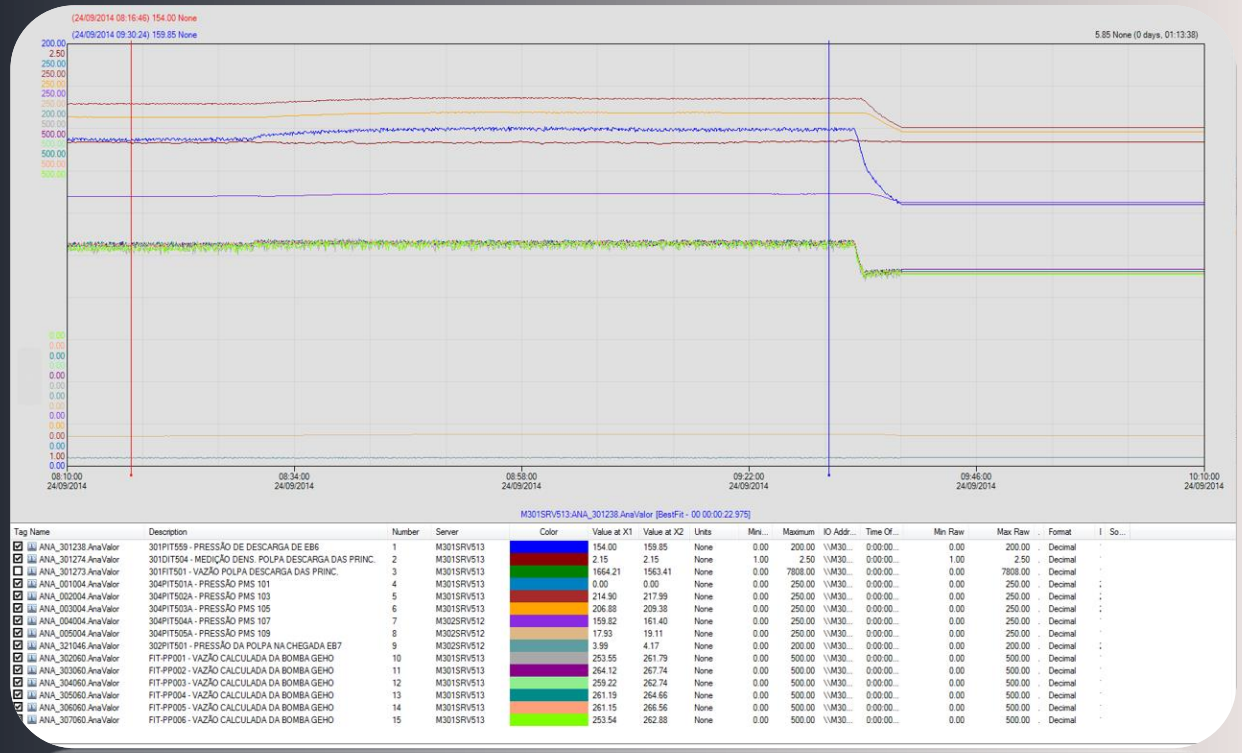
Commissioning

Load test - Pipeline

Commissioning

System analysis (Water)

- Operational data analysis
- Evaluation of the system as an overall
- Check station elevation using static head
- Determine pipeline roughness



Commissioning

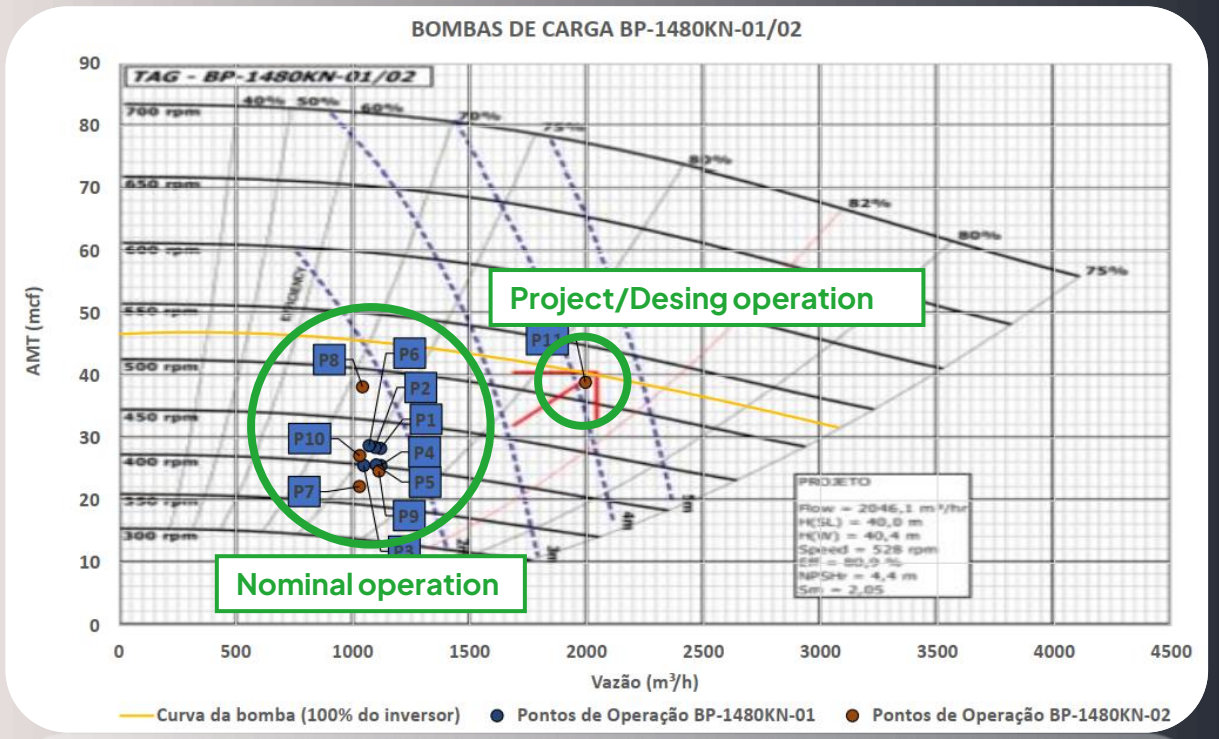
System analysis (Water)

- Validation of Operation Manual
- Startup and Shutdown sequence procedure testing
- Determine adequacy of chokes

Tabela 17: Sequência de Partida do Sistema AMMCO

ITEM	OPERAÇÕES	ESTAÇÕES	OBSERVAÇÕES
1.0	**Partida do rejeitoduto com polpa**		
1.1	Posicionar a draga em uma profundidade para bombear polpa.	Draga	
1.2	Garantir que a válvula que direciona rejeito para SP-16 esteja fechada	FV-26-212	A válvula FV-26-212 deverá ser mantida trancada fechada
1.3	Fazer jogo de válvulas para permitir que apenas a linha da draga AMMCO esteja bombeando para Saracá Oeste	FV-26-213 e FV-26-214	A válvula FV-26-214 deverá ser mantida trancada aberta, enquanto a válvula FV-26-213, mantida trancada fechada
1.4	Fazer o jogo de válvulas para direcionar o fluxo para os espigotes	FV-26-252 / FV-26-253 / FV-26-254 / FV-26-269 / FV-26-270 / FV-26-271 / FV-26-273 / FV-26-274	Abertura de válvula local
1.5	Abrir as válvulas dos espigotes selecionados.	SP-25/ SP-24/ SP-23	Devem ser abertos, no mínimo, 4 espigotes
1.6	Abrir todas as válvulas de sucção e descarga das bombas.	Draga, EB1, EB2, EB3	
1.7	Certificar que a válvula de by-pass de cada bomba está fechada.	EB1, EB2, EB3	

Commissioning



General performance

- Charge slurry pump
- Pump Curve Performance
- On project operating range

What Are the Commissioning Phases?

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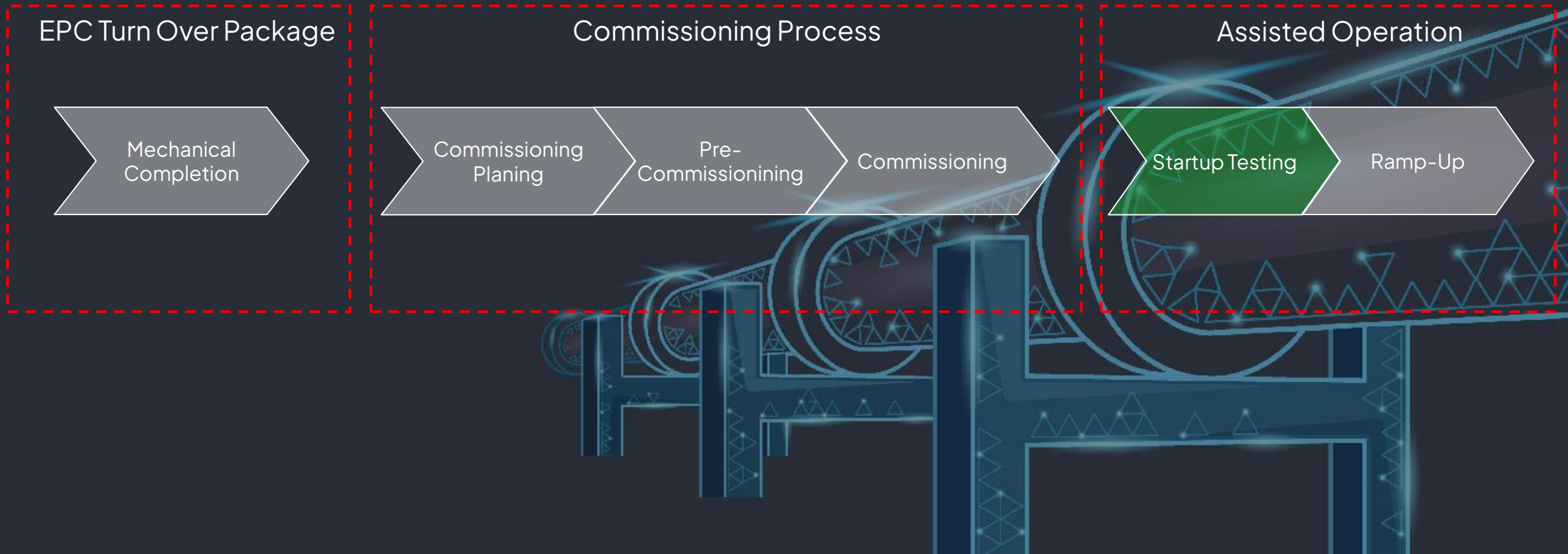


Startup Testing

Also known as **Acceptance Testing** - Dynamic Verification of the asset (all subsystems).

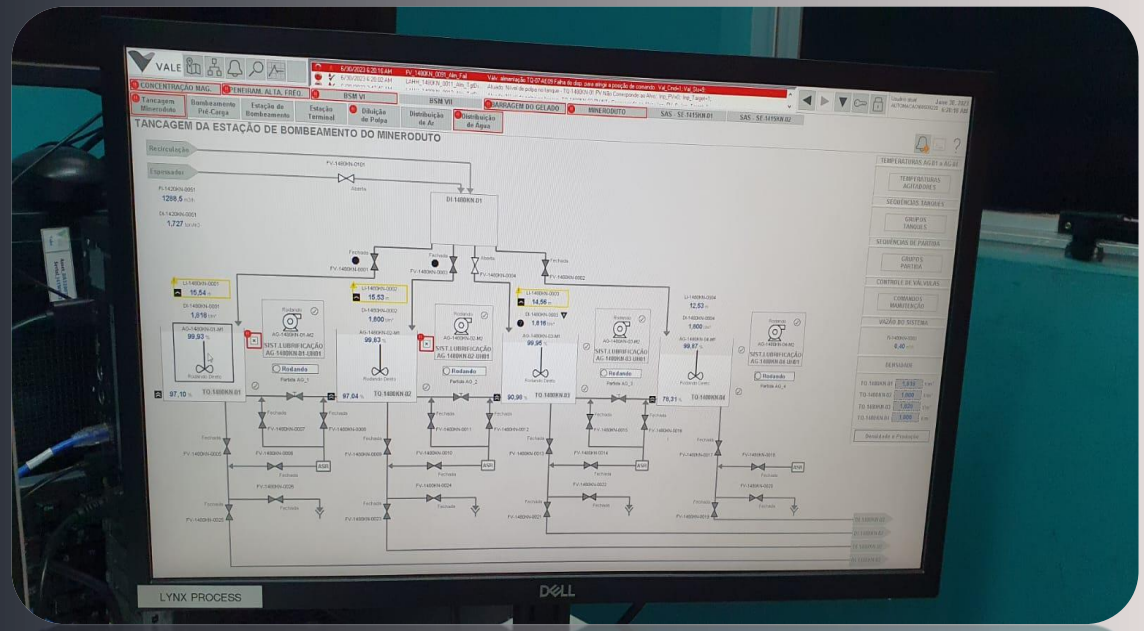
- **Load Tests Part 2, on Slurry:**
  - Adjustments on control parameter and choke settings if required (based on Water Testing results)
  - Admittance of slurry (granulometry, rheology, others)
  - Capacity or performance testing within the Operating Range
  - Shutdown and Restart at different slurry concentration
  - Slurry testing – Laboratory activities
  - Adjustments of parameters and procedures for operational optimization (Operational Manual);
  - General monitoring of the operation and endurance Testing

The execution of commissioning subsystem tests will be carried out by the commissioning team with support from the suppliers themselves.

Startup Testing

Assisted Operation

- Monitoring operation in control room through DCS.
- Monitoring operation through LDS monitor
- Slurry Lab Testing



What Are the Commissioning Phases?

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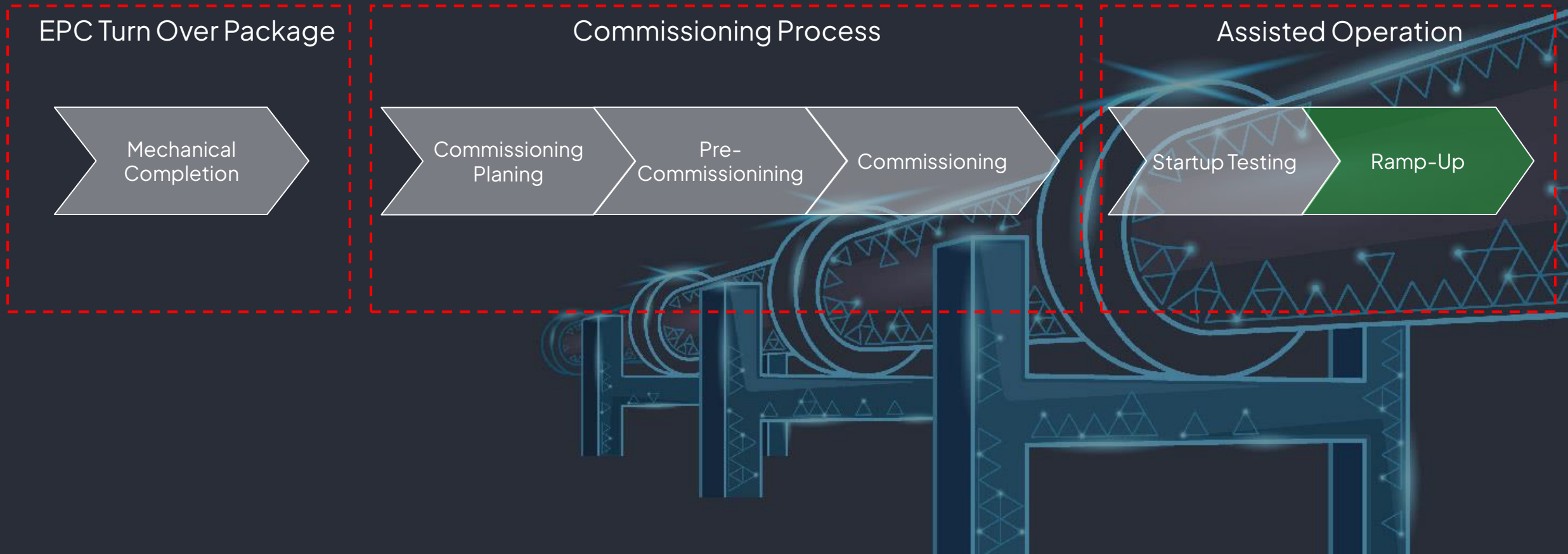


Ramp-Up

Optional – Gradually increasing production to meet product/service required capacity.

Comercial centered phase.

- Strategies of Production increase;
- Understanding customer needs;
- Validating characteristics of the transported slurry;
- Identifying bottlenecks and problems to achieve full production.

Training (Optional)

Module 1: Introduction – Basic Concepts

- Hydraulic Aspects:
  - Hydraulic concepts;
  - Bernoulli equation;
  - Pressure loss;
  - HGL (Hydraulic Grade Line);
  - Hydraulic transients
- Mechanical properties of slurry – laboratory test;
- Types of Fluids;
- Minimum transport velocity.

Module 2: Pipeline Equipment

- General project description;
- Main pipeline equipment;
- Supervisory system and control room;
- LDS screen;
- Cathodic protection;
- Auxiliary peripheral systems

Module 3: Operation and Control Philosophy

- Operational Diagram;
- Process Control and Interlocks;
- Pipeline Operation Modes;
- Equipment Groups;
  - Start-Up and Shutdown Procedures;
  - Tank Switching;
  - Booster Pump Switching;
  - Main Pump Switching.

Module 4: Maintenance, Integrity, and Emergency Plan

- Main Maintenance Procedures:
  - Weir Charge Pumps
  - GEHO Pumps
  - Slurry Filters
- Integrity:
  - Cathodic Protection Control
  - Tube Potential Measurement
  - PIG Inspection
  - Defect Correction

Mineral Pipeline Emergency Plan

Why Commissioning with BRASS?

BRASS Pipeline Commissioning

Prepared Team:

- BRASS has a solid Commissioning and Startup team that has been kept intact with an experience of over 25 years.

Available Consultants:

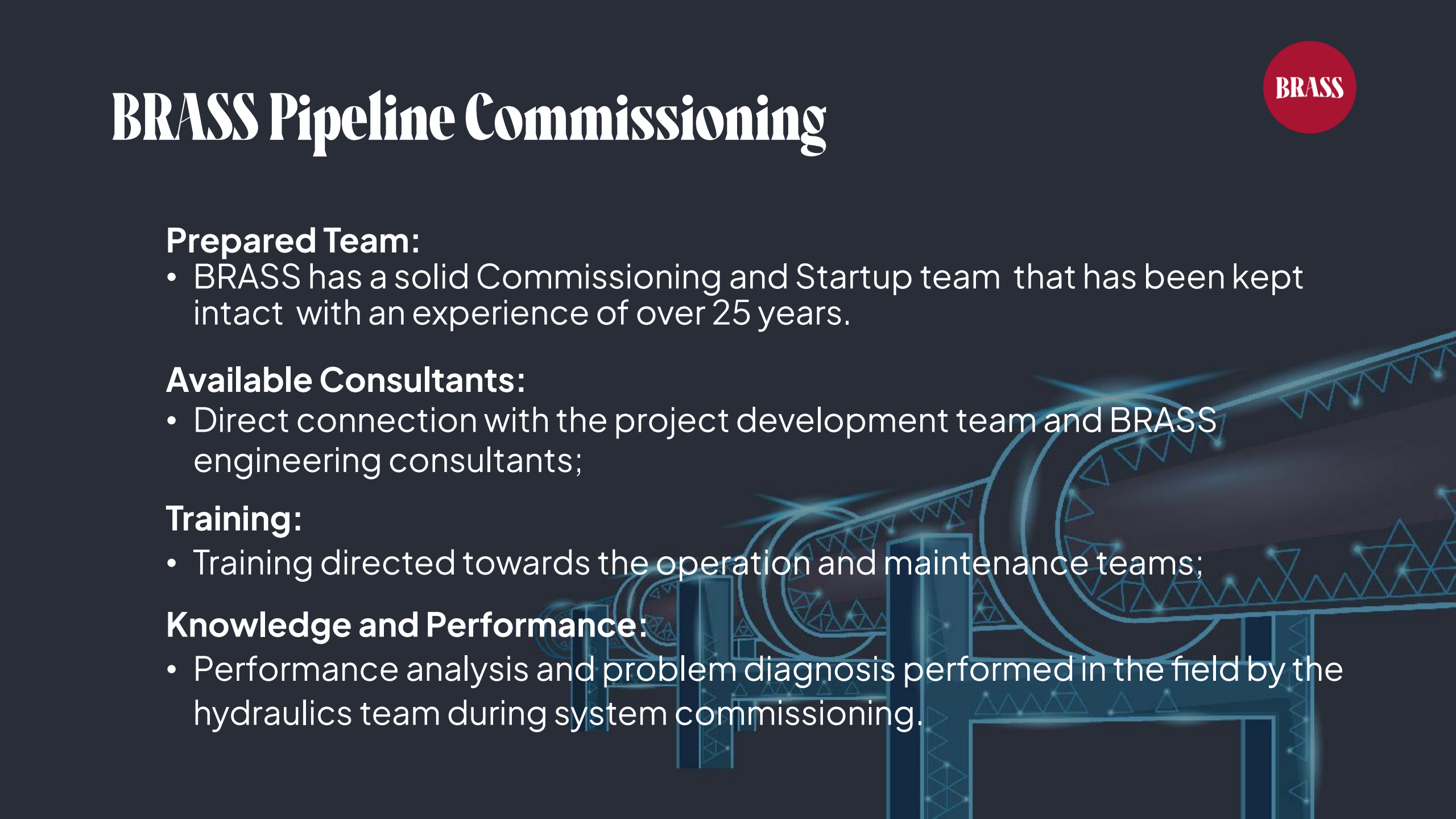
- Direct connection with the project development team and BRASS engineering consultants;

Training:

- Training directed towards the operation and maintenance teams;

Knowledge and Performance:

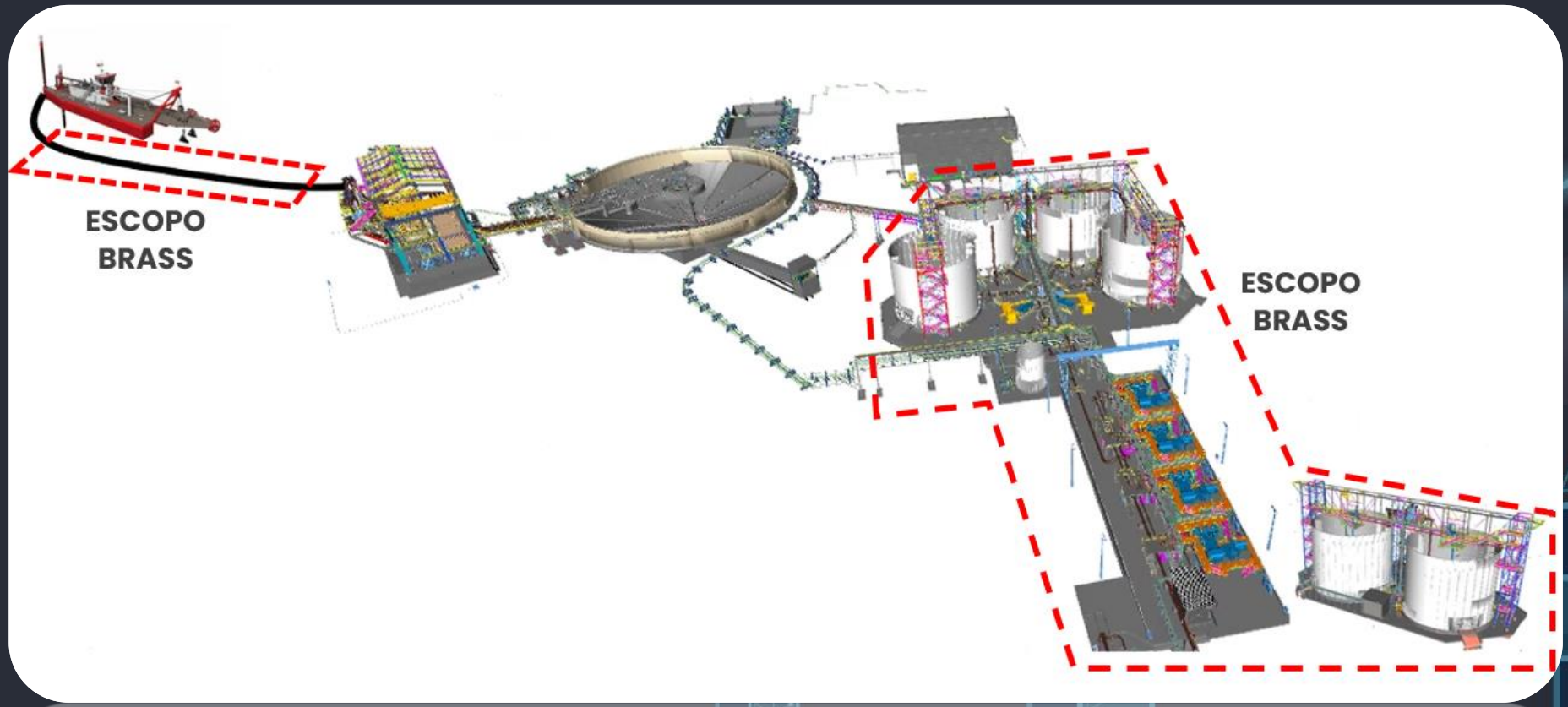
- Performance analysis and problem diagnosis performed in the field by the hydraulics team during system commissioning.



BRASS Commissioning Cases

Commissioning Cases

Gelado Pipeline – Paraopebas, PA (Brazil)– VALE



Commissioning Cases

Gelado Pipeline – Main equipment

- Tanks with agitators 21,50m x 17,00m;
- 04 hoists of 10 tons and 01 gantry crane of 15 tons
- 04 Slurry distributors;
- 02 Weir 14/12 AH Centrifugal Slurry Pumps;
- 02 Slurry Filters;
- Dilution system with 01 tank;
- 02 KSB Centrifugal Water Pumps;
- 04 Positive Displacement Pumps GEHO TZPM-2000;
- 02 Hydraulic Units;

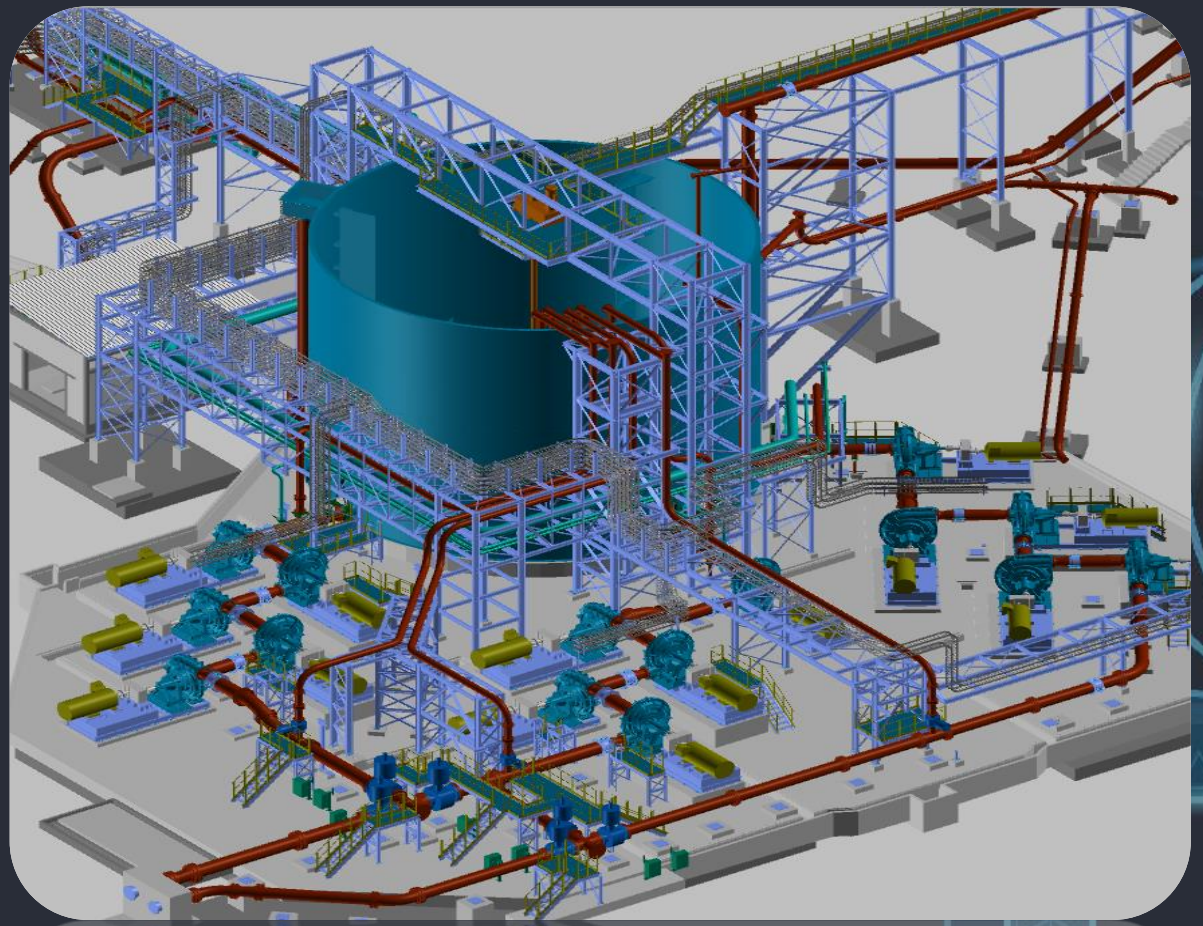
Commissioning Cases

Gelado Pipeline – Main equipment

- 35 Ball Valves with hydraulic actuation - diameters 20”, 12”, 4” and 3”;
- 13 Electropneumatic Panels;
- 59 Knife Valves with pneumatic actuation – 24”, 20”, 8”, 6”, 4” and 3” diameters ;
- 01 Launcher and 01 receiver from PIG Vanasa;
- 6,4 km API 5L X70 Carbon Steel Pipeline, 20”diameters;
- Cathodic protection system;
- Automation and Instrumentation: 09 Remote Units, Density Meters, Level Meters, Flow Meters and Pressure Transmitters.

Commissioning Cases

Central Tailings– Itabirito, MG (Brazil) – VALE



Commissioning Cases

Central Tailings – Main Equipment

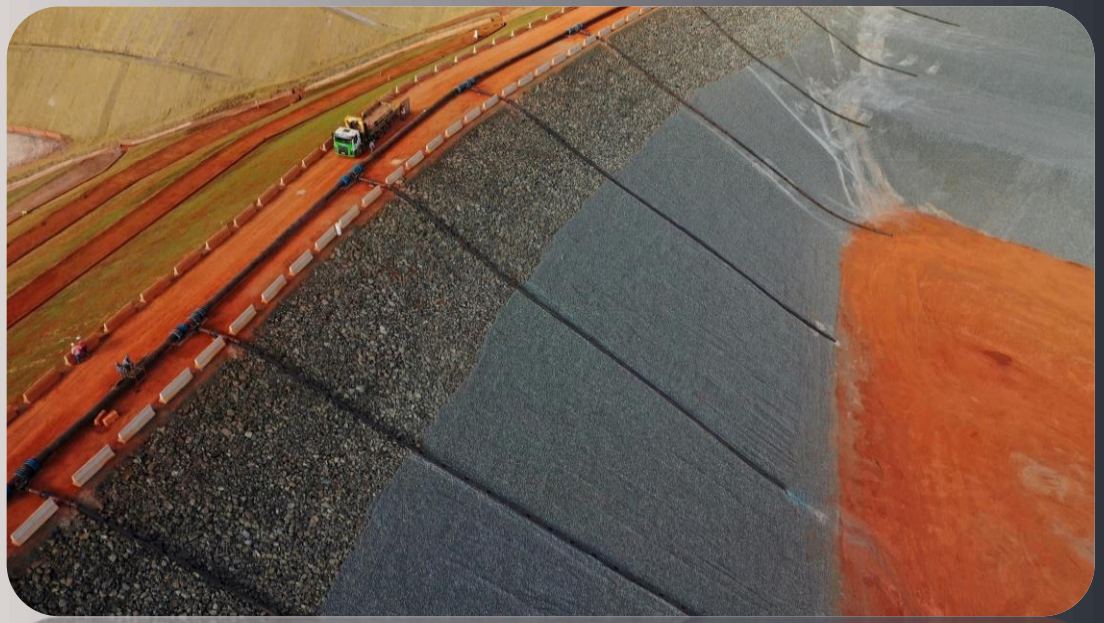
- Pump station:
  - 01 storage tank with agitator- 20m diameter and 15m height;
  - 15 centrifugal slurry pumps – Weir 14/12 AH";
  - 12 positive displacement seal pumps;
  - 24 pneumatically operated knife valves;
  - 24 ball valves with hydraulic actuation;
  - Electropneumatic panels;
  - Hydraulic Unit;

Commissioning Cases

Central Tailings – Main Equipment

- Main pipe, length 6,55km and 22” with internal lining;
- 01 Pressure Monitoring Station (PMS 1);
- Choke Station at the end of the steel section near the final margin of the dam;
- HDPE pipe downstream of the choke station.

Commissioning Cases



Central Tailings – Main Equipment

For the slurry waste pumping system to the Maravilhas III spotting, the main components are the same as those mentioned in the previous item, summarized below:

- Pump Station;
- The pipeline for waste is divided into sections:
  - From km 0,0 (Central Waste) to km 5,448 (TIE-IN) in carbon steel with an external diameter of 22” and internal polyurethane lining;
  - From km 5,448 (TIE-IN) to km 8,22 (Tank for gravity flow) in HDPE;630mm
  - From km 8,22 (Tank) to km 9,28 in HDPE 630mm;

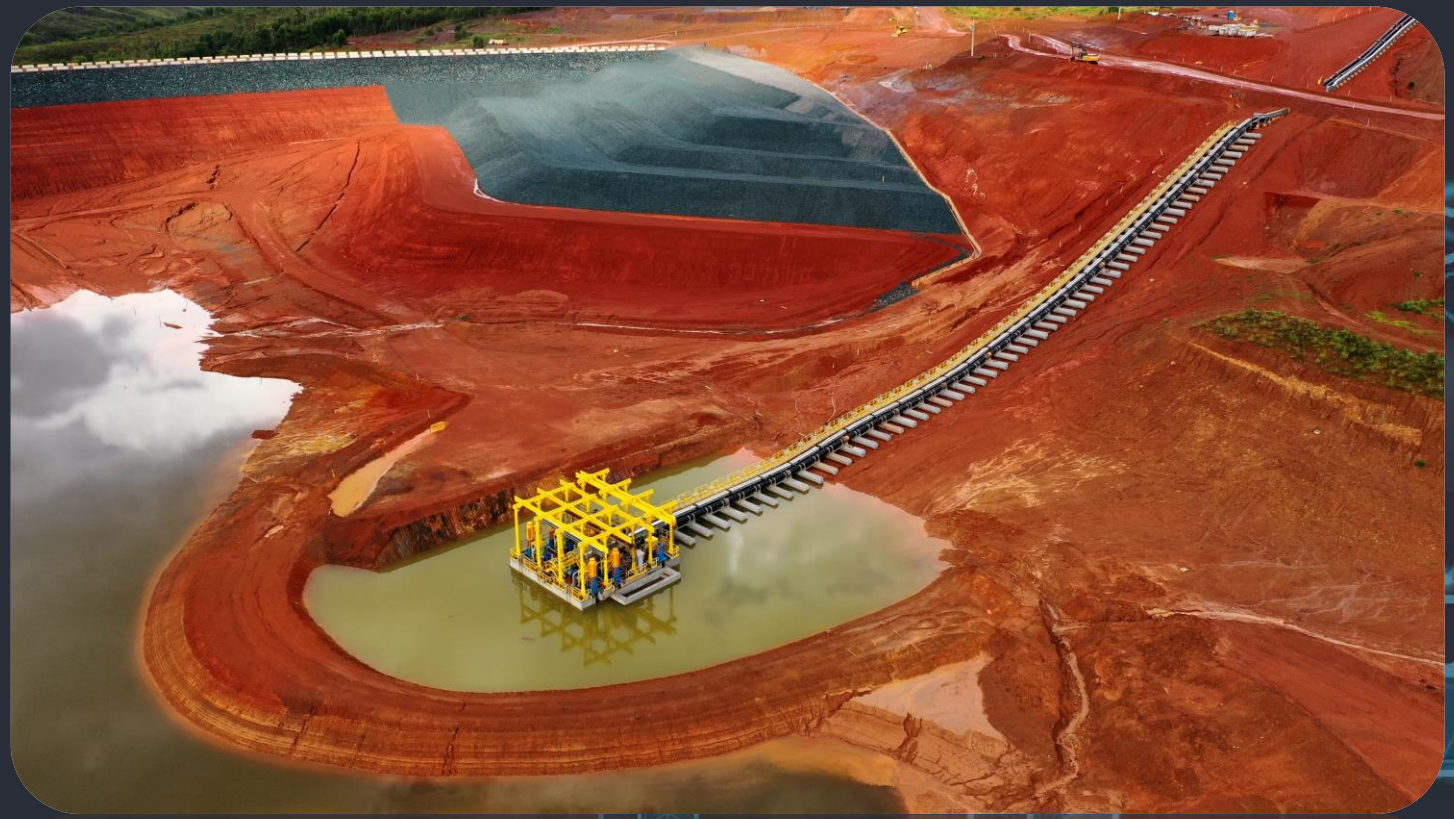
Commissioning Cases

Central Tailings – Main Equipment

- 02 Pressure Monitoring Station (PMS 01 e PMS 02);
- Terminal station LDS in km 8,0;
- 18 Spigots positioned starting from km 9,07 to km 9,28 with carbon steel branches and HDPE piping with manual sleeve valves for blocking and flow regulation, and ceramic restriction orifice.

Commissioning Cases

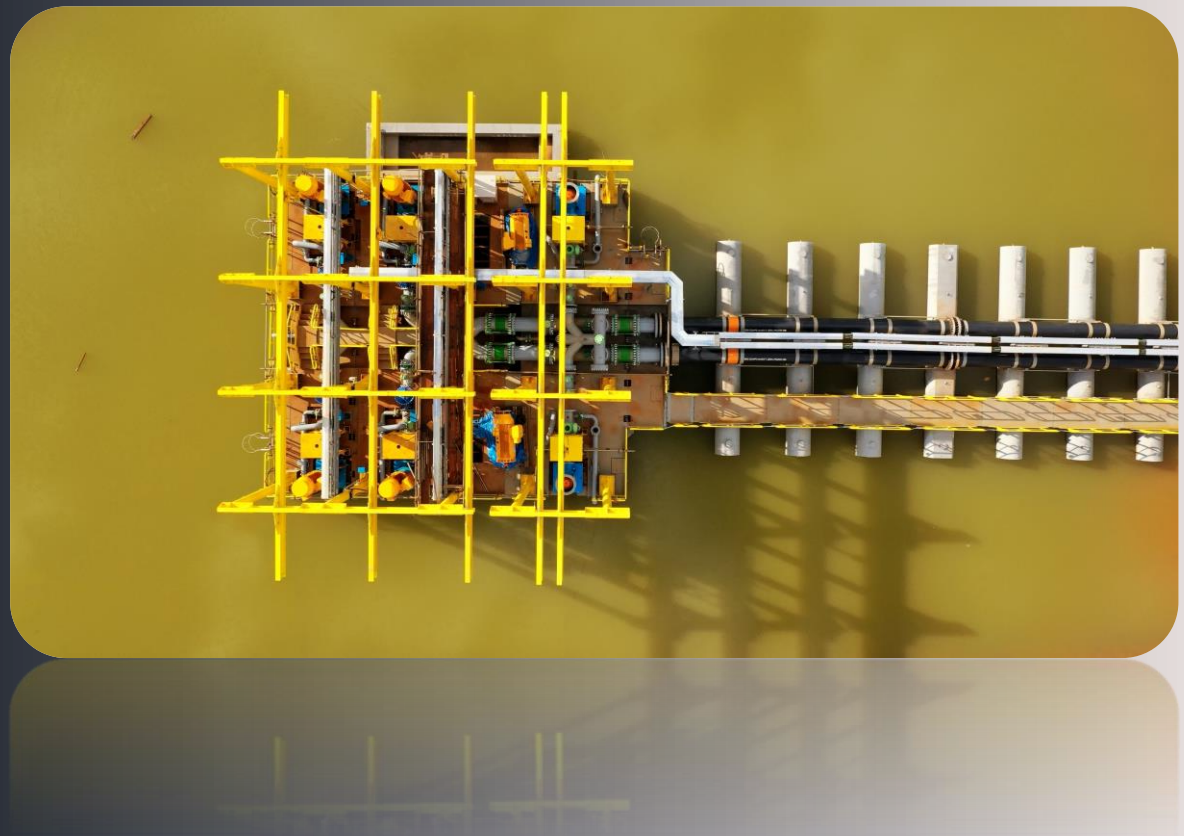
Maravilhas III Water Intake System – Itabirito, MG (Brazil)– VALE



Commissioning Cases

Maravilhas III – Main Equipment

- 01 Collection raft composed of:
  - 06 vertical centrifugal water pumps – KSB - B 22 B/5;
  - 02 HDPE pipes on 710mm – length of 580,00m each
- 01 Carbon steel Header 24” and 18”



Commissioning Cases

Maravilhas III – Main Equipment

- Pipe route:
  - Carbon steel 24” – Extension 1.650,00 meters
  - HDPE 710mm – Extension 972,00 meters
  - Four-function air valves – Total 11 units
  - Valves:
    - PCV’s (Pressure Sustaining Valve) - 05 units
    - PSV’s (Relief Valve) – 02 units

  - Carbon steel 18” – Extension 1.650,00 meters
  - HDPE 710mm – Extension 972,00 meters
  - Four-function air valves – Total 11 units
  - Valves:
    - PCV’s (Pressure Sustaining Valve) - 03 units
    - PSV’s (Relief Valve) – 02 units

Commissioning Cases

Mineroduto III – Concentrate Pipeline – Germano, MG to Ubu, ES (Brazil) – Samarco

Commissioning Cases

Mineroduto III – Main Equipment

Pump Station- EB6

- 02 Storage tank with agitators - 21,5m in diameter x 17m in height
- 02 Centrifugal cargo pumps
- 06 Piston - diaphragm pumps

Pump Station - EB7

- 01 Storage tank with agitators - 21,5 m de diameter x 17 m high
- 02 Centrifugal cargo pumps
- 06 Piston - diaphragm pumps

Commissioning Cases

Mineroduto III – Main Equipment

- Valve Station- EV5 e EV6
- Orifice Station
- 13 Pressure Monitoring Station

Terminal Station

- 02 Storage tank with agitators - 21,5 m diameter x 17 m Hight
- 01 Rupture disc – Rupture at pressure of 86,5 kgf/cm²

Pipeline – 401,26km long, API 5L X70, nominal diameter of 20” and 22”

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Thank You