Webinar ESG

Tailings Dam Management

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Agenda

1. Opening remarks
2. Safety and operational excellence
3. Introduction to tailings dam
4. Tailings management
5. Final remarks

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Opening remarks

A year ago, we added two new pillars to our strategy

- New pact with society
- Safety and operational excellence
- Maximize flight to quality in Iron Ore
- Base Metals transformation
- Discipline in capital allocation

We are honouring our new pact with society...

…with efforts to mitigate the impacts of COVID-19

COVID-19 detection kits

5 million detection kits to Brazil

31 million items for health professionals

Construction of **field hospitals**

R$ 500 million in actions to Brazilian society

…and advancing with the reparation of Brumadinho

R$ 3.8 billion
in indemnifications[1]


Ground Zero in Brumadinho

	Emergency aid	Civil	Labour
People	+106,000	+5,800	+1,600

Communities of Minas Gerais receive additional support in the pandemic

[1]Updated on July 7, 2020

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Safety and Operational Excellence

We adopt the three lines of defense model to assure our safety and operational excellence

Vale has strengthened its governance to safety and operational processes, as well as to its geotechnical structures

Operational Excellence and Risk Committee

- Support to the Board of Directors and interact with Dam Safety Committee
- Assess corporate risk management
- Monitors operational risks, especially geotechnical ones

Extraordinary Ind. Consulting Committee for Dam Safety

- Support to the Board of Directors, through the Operational Excellence and Risk Committee
- In 2019, it held 19 meetings, spent 40 days in field trips and released 16 reports to the BoD
- Committee will be maintained until April, 2021.

Executive Risk Committee for Geotechnics

- Support to the Executive Board
- In 2019, Board has approved a new risk policy and since then four Executive Risk Committees have been created, one with focus in geotechnical Risks

Safety and Operational Excellence Office

- Report to the CEO
- Responsible for the review of the Tailings Management System, the relaunch and review of Vale Production System and global maintenance structure.

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The second line of defense is managed independently from operations

- Development of a new and transformed Tailings Management System.
- Ensure the application of best practices to continually monitor mine waste facilities.
- Support to the EoR (engineer of record) implementation.
- Technical support to the risk management process (methodologies and process).
- Authority to stop any given operation whenever necessary

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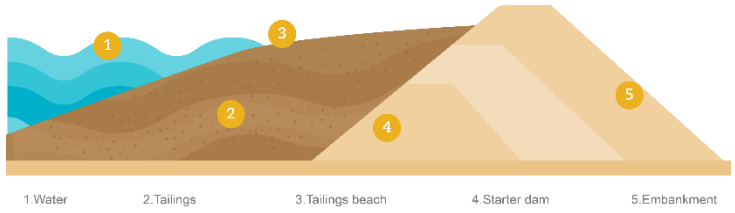
Introduction to tailings dam

Tailings dam are used to store liquid, solid, or a slurry of fine particles

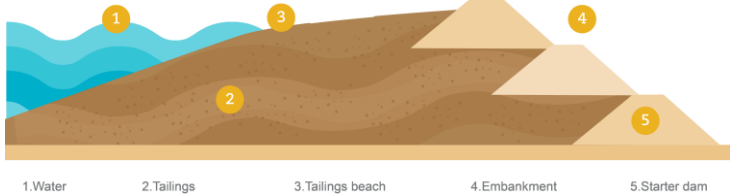
Downstream

The downstream shell is built on compacted soil, regardless of the type of tailings used. It is built in the direction of the water flow (downstream).



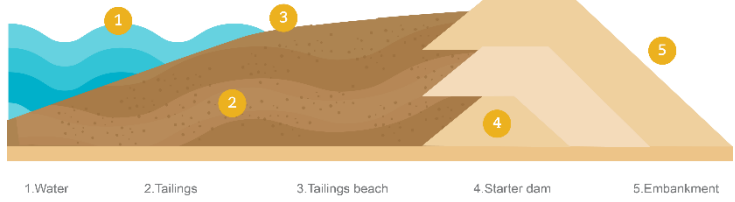
Upstream

The dam body is constructed using the deposited tailings. It is built in the opposite direction of the water flow (upstream). The dam needs thick tailings so that the shell can be constructed.



Centerline

The centerline method is a hybrid of upstream and downstream designs. In Centerline construction, the dam is raised vertically from the starter dam.

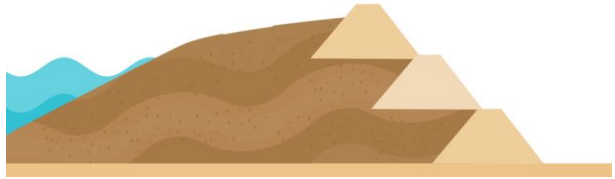


Solid tailings are often used as part of the structure itself

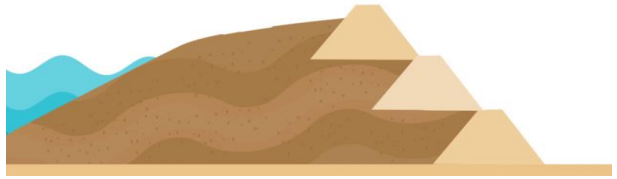
Tailings storage facilities requires continuous management and risk assessment for the most common failure mechanisms

- **Overtopping:** Water volumes exceed the capacity of the dam
- **Slope stability:** The slope is stable, if the available shear strength of the tailings/soil exceeds that required to keep the slope stable
- **Foundation failure:** Soil or rock below the dam is too weak to support the dam
- **Liquefaction:** The solid material begins to act and move like a liquid. Can be static or dynamic
- **Internal erosion:** Seepage within or beneath the embankment causes erosion along its flow path

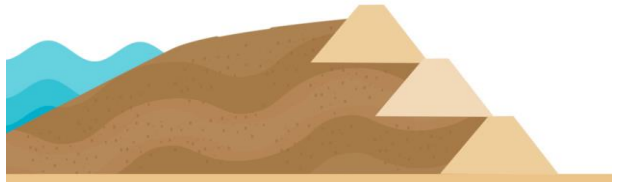
Monitoring, inspections and reviews from internal and external experts



Overtopping illustration



Internal erosion illustration



Dynamic liquefaction illustration

Vale's tailings dam portfolio is concentrated in Brazil

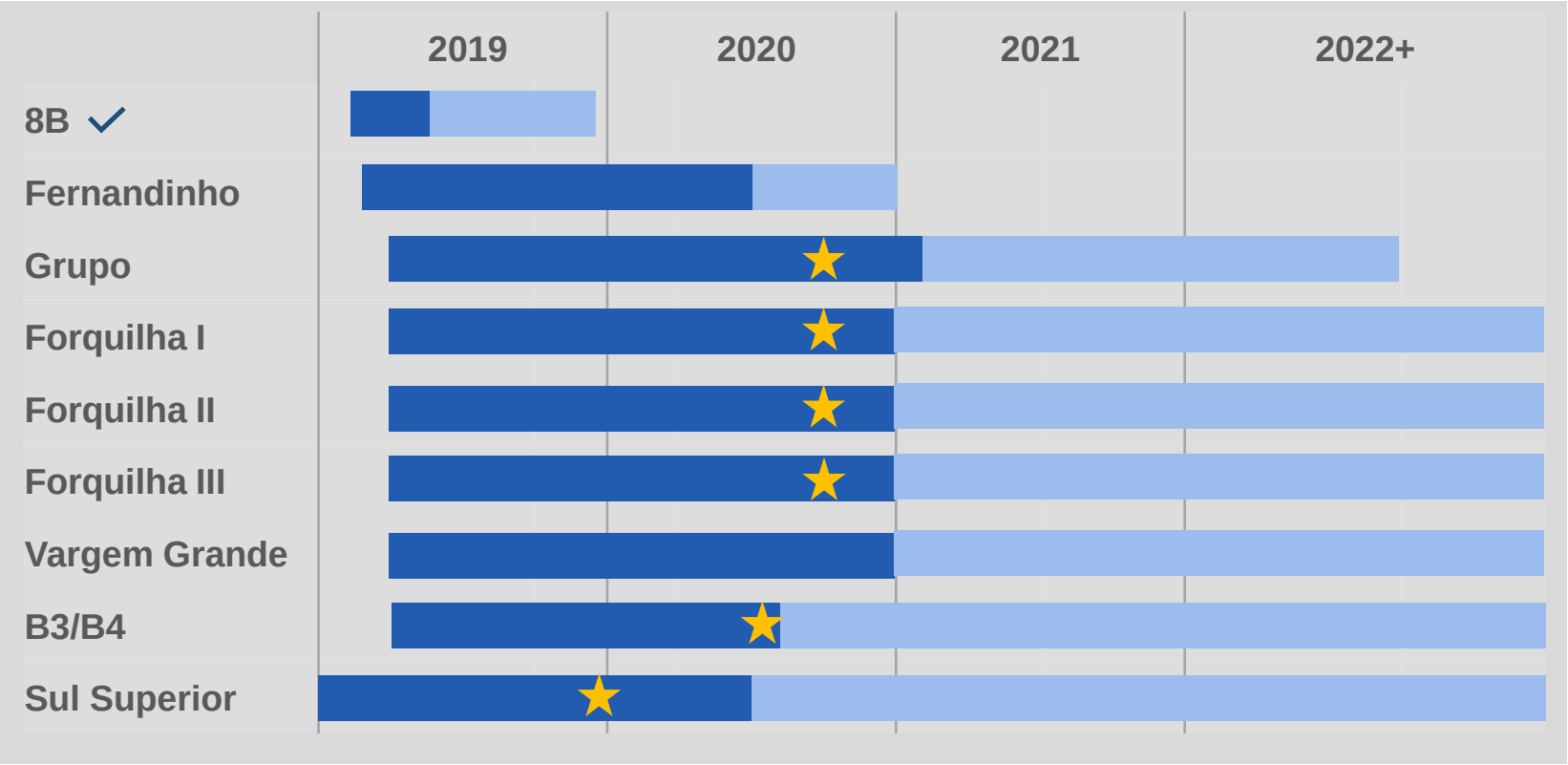
Location and operational status of operated tailings storage facilities[1] (TSF)

- Active
- Inactive[2]
- Under construction
- TSF upstream method

64 operated tailings facilities
- 27 active
- 35 inactive
- 2 under construction

[1] Includes facilities within Vale operations and excludes Non-operated Joint Ventures (JVs). Vale's non-operated JVs has 21 active and 5 inactive structures, of which 2 structures are upstream. The number of tailings storage facilities is calculated based on the definition agreed by the International Council on Mining and Metals Tailings Advisory Group in response to the Church of England information request, which may differ from Brazilian National Mining Agency definition.
[2] Inactive includes facilities not in operational use, under maintenance and in post-closure care and maintenance.
For further details on tailings dam in our portfolio please see our more detailed disclosure here.

Vale is evolving with the de-characterization of upstream tailings dams and other structures in Brazil



Other structures to be de-characterized:

- Doutor, Campo Grande dams and three drained stacks are in engineering phase
- Pondes de Rejeitos, base metals dam, will be concluded in Dec/20
- Smaller upstream structures. First one will be concluded in Dec/20

Note: The schedule may change until the phases are completed and according to public agencies.

Vale has completed the containment structure for Sul Superior

Despite the COVID scenario, the works on containment structures continued as considered essential to safety

Containments for Forquilhas and Grupo

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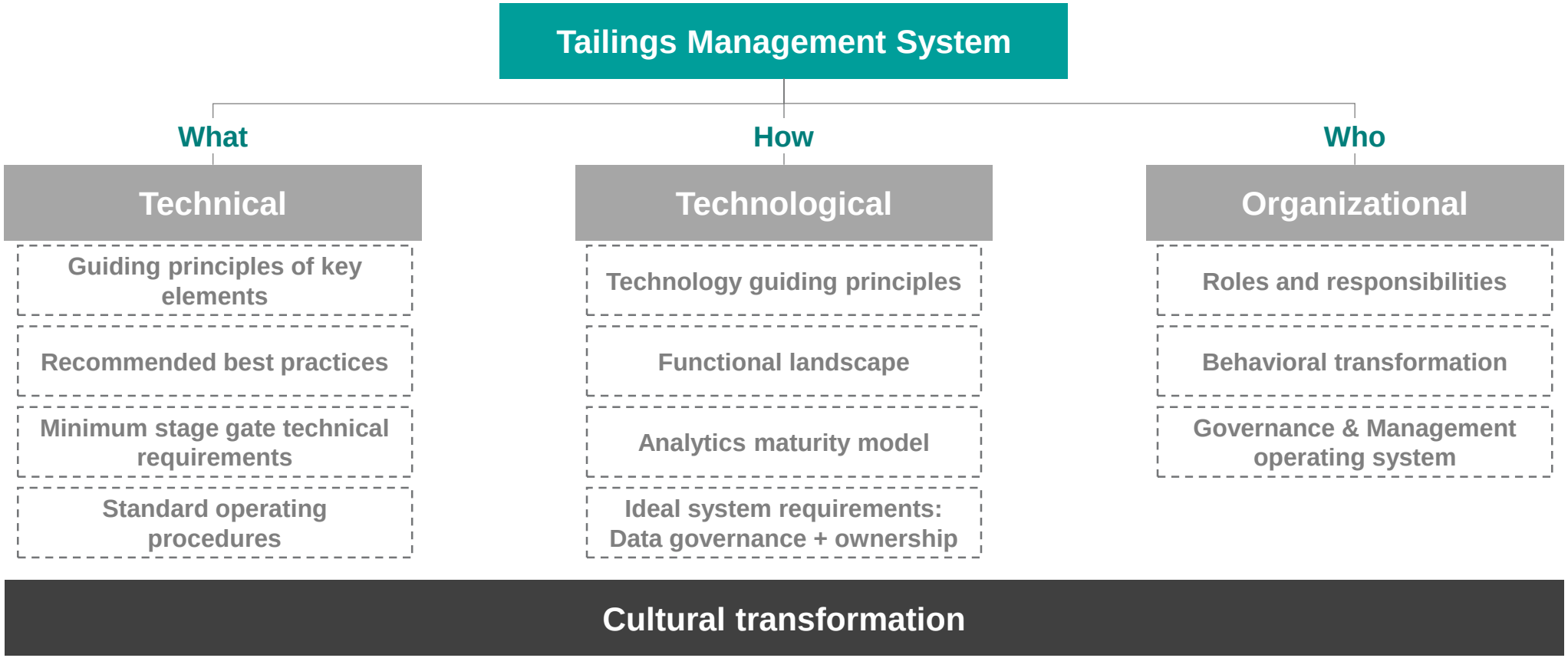
Tailings Management

We are implementing a new Tailings Management System



To design Vale's tailings management system, gaps were assessed for each key element

Project Phase

- Planning
- Design
- Construction / Implementation
- Operation
- Care and Maintenance / Closure / Post-Closure

Standard Operating Procedures

- Dam Classification
- Water Management Guideline
- Dewatering Technology Selection
- Closure Planning
- Geotechnical Investigation
- Geotechnical Analysis
- Hydraulic Structures
- Dam Break Analysis
- Risk Management
- Quality Assurance and Quality Control Program
- As-Built Report
- Operation, Maintenance and Surveillance Manual
- Emergency Preparedness and Response Plan
- Change Management
- Monitoring & Design Verification
- Dam Safety Inspection
- Dam Safety Review

International Standards

ICMM
International Council on Mining & Metals

The Mining Association of Canada
ADVOCACY STEWARDSHIP COLLABORATION

CDA ACB

25 geotechnical normative documents under development to fully comply with the standards

Geotechnical Monitoring Centers run 24/7 basis for 100 structures

Geotechnical systems evolutions

Trigger response plans and alerts system

New dam monitoring technologies

- Real time piezometers monitoring
- Video analytics with artificial intelligence
- Geophones to measure dam’s response to seismic activity
- Radars ensure fast response and precision
- Satellite, drone imagery and sound alarms

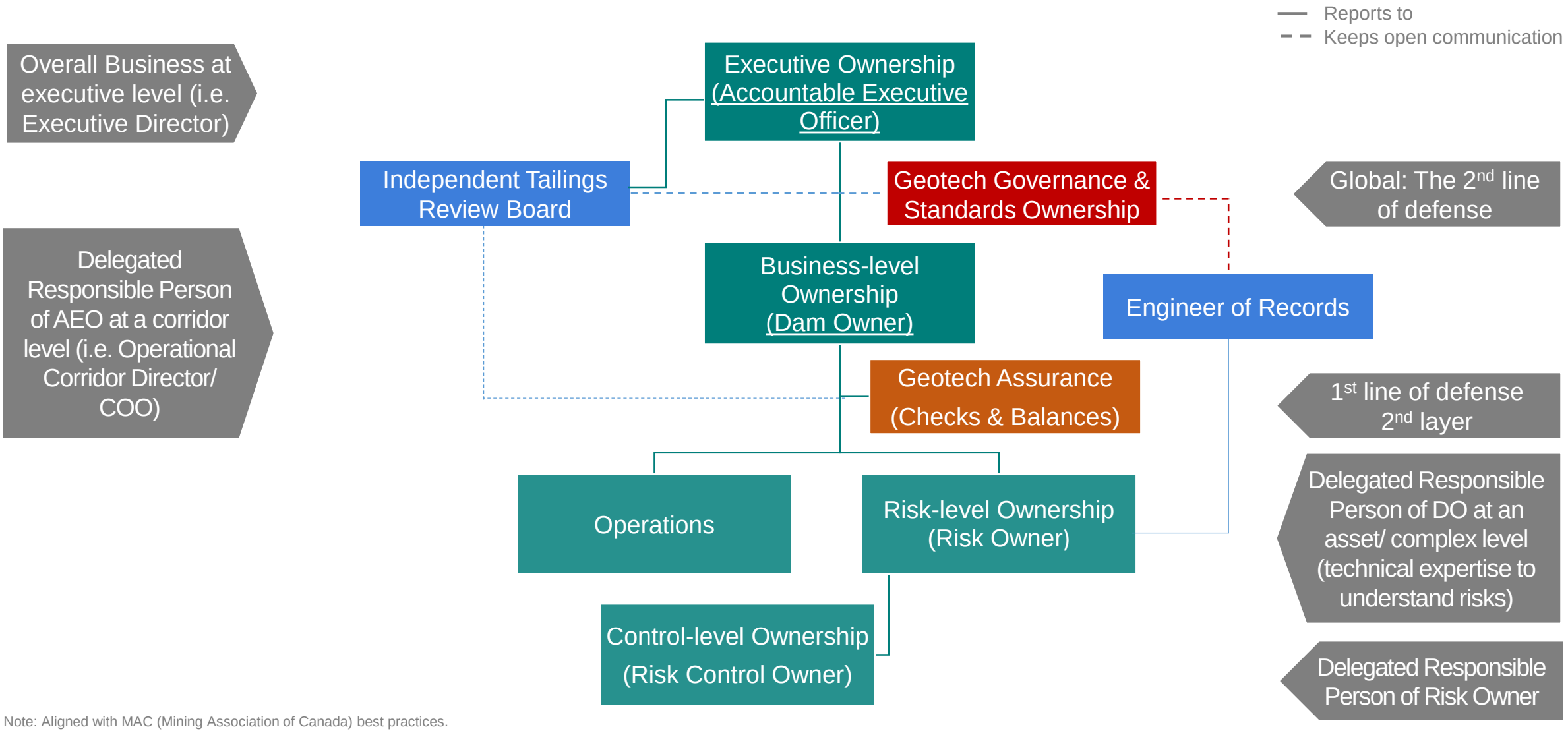
RASCI[1] matrix to define roles and responsibilities

72 key processes, including:

- Governance
- Design and planning
- Construction
- Risk management
- Operations
- Audits and Reviews
- Closure
- Emergency Preparedness

[1] RASCI matrix: Responsible, Accountable, Supporting, Consulted and Informed.

Roles and responsibilities are being reviewed and aligned with international best practices



Note: Aligned with MAC (Mining Association of Canada) best practices.

Our Tailings Management System is based on three levels: Routine, Performance and Risk (RPR system)

Routine

Continuous Check of Operational Discipline

Basic Geotechnical Guidelines

Define the KPI´s for the Routine Periodic assessment by the Geotech assurance team

Dashboards with key performance indicators being prepared and used in the operational meetings

Performance

Continuous Check of the Tailings Dam Geotechnical Performance

EoR (Engineer of Record)
Prepare a formal monthly safety report based in the geotechnical monitoring and field inspections.

Summary reports to be sent to Senior management level

17 EoR's hired for Iron Ore

EoR's responsible by Dam Safety Inspections

Risk

Failure Modes and Critical Controls Mapping

Dam Portfolio Risk Assessments through HIRA (Hazard identification and risk analysis)

Full integration with the Enterprise Risk Management (ERM)

All dam portfolio covered until end of 2022
Three global consulting companies supporting Vale

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Basic Geotechnical Guidelines

Routine

Performance

Risk

Monthly Indicator

KPI's and dashboards

- Business risk integration
- Routine and special inspections
- Adherence to recommendations
- Monitoring and instrumentation
- Legal requirements

Semiannual Indicator

- Dam breach study
- Maintenance, operation and surveillance manual
- Dam safety inspection
- Emergency preparedness and response plan
- Dam safety review
- Governance effectiveness
- Water management
- Life cycle planning
- Change management

Per status	
Effective	
Partial Effective	
Not Effective	
Non Applicable	

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Engineer of Record and the continuous performance assessment

Routine

Performance

Risk

- The **EoR is external to the operations** and is integrated with Vale's lines of defense
- Model of **continuous monitoring,** and a more rigorous one. Better integration of the dams' information and databases
- Regular security inspection, and issues **monthly technical reports**, continuously interpreting the results of the inspection and monitoring activities of the structures
- New upgrades or downgrades of Declaration of Stability **("DCE") may be issued at any time throughout the year***
- **Good practice** recommended by MAC (Mining Association of Canada), CDA (Canadian Dam Association) and the Extraordinary Independent Investigation Committee

Guidance Table for Classification of the Dams Geotechnical Performance Condition

- Satisfactory without restriction
- Satisfactory with restriction, without compromise safety
- Satisfactory with restriction, possibly compromising safety
- Unsatisfactory

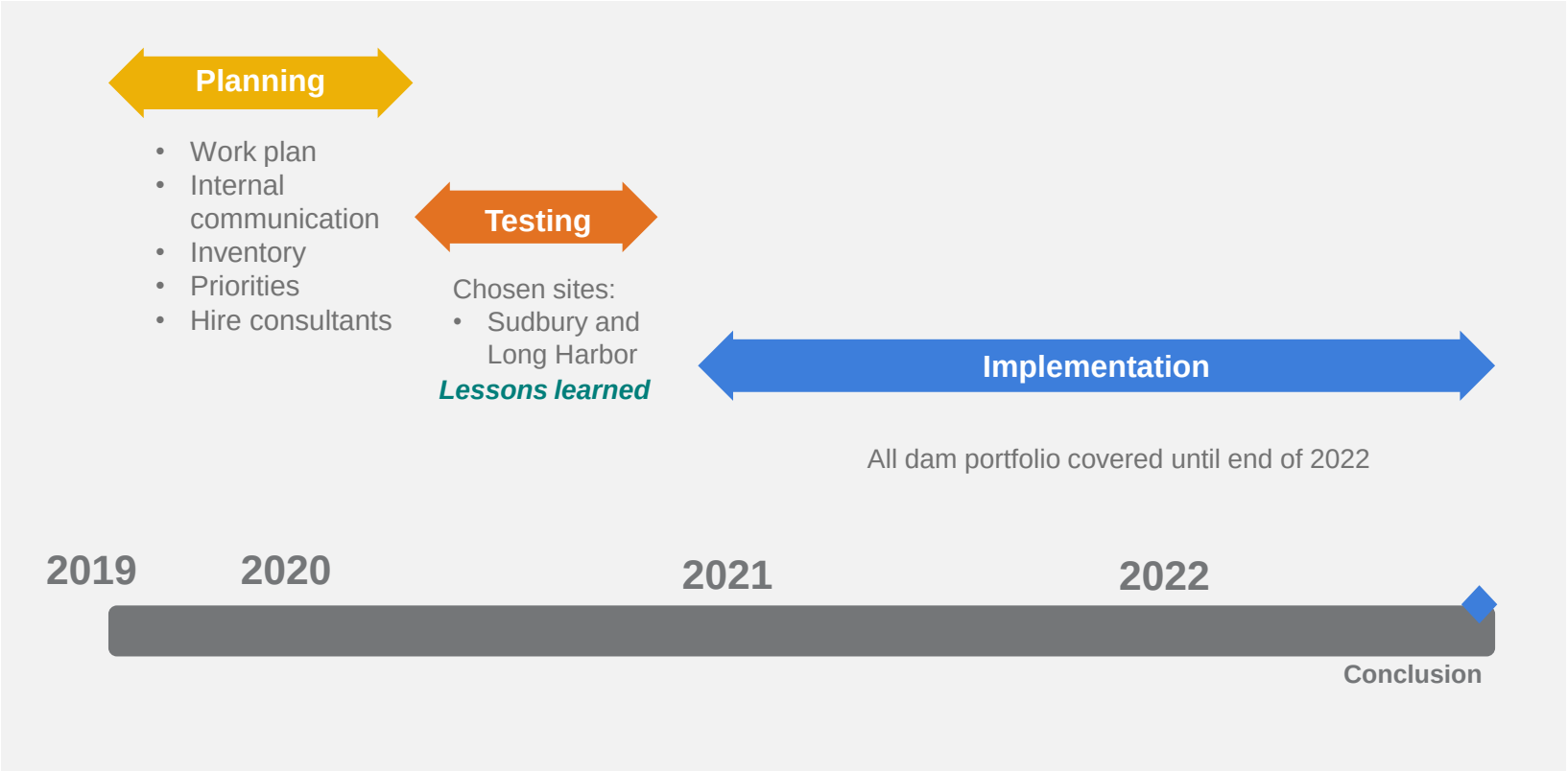
* DCE issue only in Brazil (legal requirement)

Dam portfolio risk assessments through Hazard Identification and Risk Analysis (HIRA)

Routine

Performance

Risk



- Pilot carried out in Canada during 1H20
- Three global companies working across the portfolio - 2 years to complete
- Teams composed of geotechnicians from all lines of business, exchange of experiences

Portal in geotechnics to share expertise and disseminate knowledge

Data base with technical articles, standards and guidelines

Technical studies calendar

Integration workshops

Geotechnical specialization course

- 360h (soil and rock mechanics, engineering geology, tailings disposal, risk management)
- 40 professionals/year (including community professionals)
- Partner: Ouro Preto Federal University

Geotechnical team is also part of Vale's Cultural transformation with transparency, responsibility and technique

Roles are clear	People understand their roles and responsibilities
Accountabilities are defined	There is clear accountability at both process and personal level
Geotechnical team leads the way	Clear Geotech Engineer Identity and succession planning
Lines of defense in place	Boundaries are set and all stakeholders understand their part
VPS is integrated and in action	VPS is internalized and becomes a compass for decision-making

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Case 1: Brucutu

- On December 2019, Vale proactively decided to suspend temporarily the disposal of tailings at the Laranjeiras dam, originated at the Brucutu plant, while assessing the **dam's geotechnical characteristics.**
- The decision was taken after conjoint examination from different teams, **as well as the second line of defense,** with independency from production goals, regardless of potential production impacts.
- During the assessment, which still in place, the Brucutu plant, an important source of pellet feed for Vale, will run with 40% of its production capacity.
- Action plan towards stability declaration (DCE): Execute a geotechnical investigation to check the need of a dam reinforcement.

Case 2: Itabiruçu

- On October 2019, Vale proactively decided to suspend temporarily the raising construction and disposal of tailings at the Itabiruçu dam, while assessing some deformations associated with the raising works.

- The decision was taken with the recommendation from **the second line of defense, in line with auditors, even for a dam with stability declared by the external auditor (positive DCE).**

- The dam still remains with positive DCE but was decided by 2nd and 1st line together the EoR to finish all the engineering studies to return with the raising construction.

- Action plan towards return to the raising works: Finalize the engineering and deformation modelling, expected for mid-August.

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Final Remarks

Our new tailings management approach is based in a multi layers of protection, improving our capacity to avoid accidents

Business units		Safety & Risk	Internal audit		External sentinels		
Geotechnical operations team	**Geotechnical support team**	**Safety & Operational Excellence Office**	**Independent Board Committee for Dam Safety**	**Chief Compliance Officer** Internal audit and whistleblower channel	**Engineer of Record** Dam safety inspections and performance assessments	**Independent Auditors** Public Prosecutors technical reviews and Tailing Review Boards	**Dam Safety Reviews** Periodical technical reviews by external engineering company
1st layer	**2nd layer**	**2nd line of defense**	**3rd line of defense**				
1st line of defense							

Our objectives

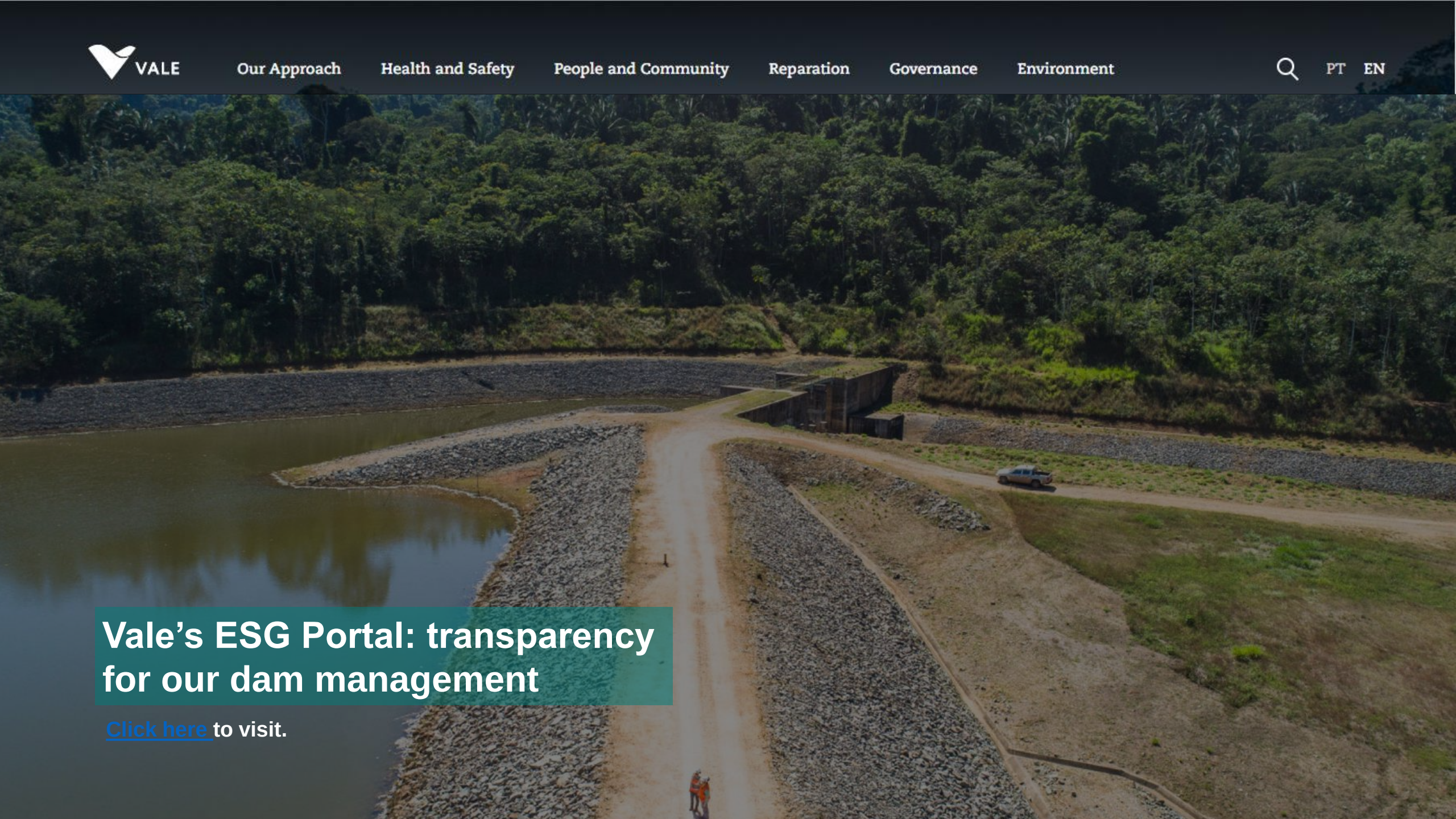
1. **Finalize the new Tailings Management System implementation across all business by December 2020, aligned with best international practices**

2. **Complete the As-Is drawings, operational manual, and emergency plans of all structures by December 2020 (85% concluded)**

3. **Improve our internal and external technical capacity**

4. **De-characterization of upstream dams and other structures in Brazil**

5. **Increase dry processing operations, expected to reach 70% of the iron ore production volumes by 2023**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Our Approach
Health and Safety
People and Community
Reparation
Governance
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PT
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Vale’s ESG Portal: transparency for our dam management
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