To Norges Bank

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Recommendation to exclude Vale SA from investment by the Government Pension Fund Global (GPFG)

Summary

The Council on Ethics of the Government Pension Fund Global (GPFG) recommends that Vale SA (Vale) be excluded from investment by the fund due to an unacceptable risk that the company is responsible for serious environmental damage.

Vale is the world's largest producer of iron ore and has various types of mining operations and other activities in approx. 30 countries. In November 2015, a tailings dam at a mine in Brazil belonging to the company Samarco, a joint venture in which Vale has an equal partnership with BHP Billiton. 19 people died, and the damage to the environment was severe. An inquiry commissioned by BHP Billiton found serious faults at the dam. These faults were of a kind that makes it probable the company was aware of them.

In January 2019, another of Vale's tailings dams in Brazil collapsed, causing a provisional death toll of 237 people. The inquiry into this accident has not yet concluded, but there are several similarities between the two incidents. Failures in the dams' construction, maintenance and monitoring have been identified. Vale has a total of 45 tailings dams in Brazil.

An additional element in the Council on Ethics' assessment is the fact that the company had sited office and canteen facilities downstream of the dam, and had failed to establish adequate warning systems to avoid significant loss of human life.

Regardless of what caused the accident in 2015, the measures subsequently implemented by the company were insufficient to avoid the 2019 collapse.

The Council on Ethics has considered these two accidents with respect to the ethical guidelines' criterion on environmental damage, and recommends the company's exclusion on this basis.

Contents

1 Introduction

The Council on Ethics for the Government Pension Fund Global (GPFG) has assessed the fund's investments in Vale SA (Vale)[1] against the guidelines for observation and exclusion from the GPFG (ethical guidelines).[2] Vale is the world's largest producer of iron ore and has mining and various other activities in approx. 30 countries.

At the close of 2018, the GPFG owned 1.1 per cent of the shares in Vale, with a market value of NOK 6.6 billion.

1.1 Matters considered by the Council

The Council on Ethics has considered whether there is an unacceptable risk that Vale SA is contributing to or is itself responsible for severe environmental damage. The starting point for its assessment is the collapse of two tailings dams (in November 2015 and January 2019) that resulted in extensive environmental damage and substantial loss of human life. The Council on Ethics has not considered the totality of the company's business operations, but has focused on matters relating to the risk of dam breaches in Brazil.

Section 3(1) of the GPFG's ethical guidelines states that companies "*may be put under observation or be excluded if there is an unacceptable risk that the company contributes to or is responsible for [...]* c) *severe environmental damage*".

In other cases in which the Council has considered exclusion under this criterion, it has attached importance to the following factors, amongst others:

- the scale of the environmental damage,
- whether the damage is irreversible,
- whether the damage has a significantly negative impact on human life and health,
- whether national legislation or international conventions have been violated,
- whether the company has failed to take action to prevent damage being caused,
- whether it is probable that the company's unacceptable practices will continue

1.2 Sources

The Council on Ethics has not itself examined conditions at Vale's mines in Brazil, but relies on a substantial volume of openly available documentation on dam safety in general and these two accidents in particular. The Council has accorded substantial weight to the report from the panel which the company appointed to investigate the Samarco accident (the Morgenstern Report), research documents produced by the company's own employees, information provided by the prosecuting authorities and documentation from the certification body the company uses with respect to dam safety.

[1] Issuer ID 136117

[2] Guidelines for Observation and Exclusion from the Government Pension Fund Global (GPFG): http://etikkradet.no/files/2017/04/Etikkraadet_Guidelines-_eng_2017_web.pdf

2 Background

2.1 About the company

Vale is a Brazilian mining company with operations in around 30 countries.[3] The company is the world's largest producer of iron ore, iron pellets and nickel. It has a substantial mining operation in Minas Gerais, Brazil. It extracts ore both alone and in conjunction with others, for example the joint venture called Samarco, which is owned 50-50 by Vale and BHP Billiton.[4]

2.2 The incidents concerned

On 5 November 2015, Samarco's Fundao Dam, near Mariana in Minas Gerais, Brazil, collapsed. The dam was approx. 110m high and of the *upstream* type. When it collapsed, releasing more than 30 million cubic metres of wet tailings, the village of Bento Rodrigues was destroyed and 19 people are assumed to have died in the torrent of mining waste. The slurry spilled into the local watercourse, which it followed for 650km until it reached the Atlantic coast 17 days later, polluting large areas of the coastline. Rivers and streams suffered substantial and long-lasting damage. There were no reports of heavy precipitation in connection with the dam's collapse, but three small earthquakes had been registered shortly before.[5]

Scarcely three years later, on 25 January 2019, another of Vale's tailings dams, called Dam 1 and located near Brumadinho in Minas Gerais, Brazil, collapsed. Dam 1 was 86m high and was also of the upstream type. The dam was full and was no longer in use, but it had not been decommissioned. It was last filled with tailings in June 2016. It has been estimated that almost all of the dam's 12 million cubic metre contents was released in the collapse. It caused extremely extensive damage both locally and on down the watercourse. The final number of fatalities will probably climb to around 300. Many of those who died were in the company's cafeteria downstream of the dam. There have been no reports of heavy precipitation or any other sudden incidents which may have triggered the dam's collapse.

2.3 Management of mining waste (tailings)

Iron ore is extracted by crushing the ore-bearing rock and separating it from the non-ore-bearing components in the rock using a wet or dry process. The wet process produces vast quantities of watery waste, called tailings. These tailings will contain some metals which are partially soluble in water and which could oxidise, making them harmful if released into a watercourse. The damage comes not only from the toxicity of the metal compounds, but also because oxidation reduces the oxygen level in the water, causing aquatic organisms to suffocate. Furthermore, the sludge clogs the watercourse, choking plants and animals, and substantially changes the water's pH balance. Different types of ore produce different effects.

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[3] http://www.vale.com/EN/aboutvale/Pages/default.aspx

[4] *"Samarco's Corporate Governance structure is formed by its shareholders BHP Billiton do Brasil Ltda. and VALE S.A. (each with a 50% interest)"* https://www.samarco.com/en/diretoria-samarco-e-conselho-de-administracao/

[5] See *Report on the immediate causes of the failure of the Fundao dam*. http://fundaoinvestigation.com/wp-content/uploads/general/PR/en/FinalReport.pdf

Tailings are often stored in artificial ponds, or dams, surrounded by earth banks. The stability of a tailings dam depends on several factors, but the key is to keep control of the water saturation level and drainage, so that the mass does not undergo liquefaction, a process whereby it transforms from a solid to a liquid and begins to flow, eventually breaching the dam's retaining wall. Such dams can contain many millions of cubic metres of tailings, and must be constructed, operated and monitored extremely carefully to ensure their stability. One method of constructing such dams, called the upstream method, appears to be slightly more difficult to build and operate safely than other types of dam. However, it is often cheaper to set up.[6] Vale has 148 dams for various purposes in Brazil, several of which are of the upstream type. Historically, breaches have occurred in many different types of dam, not just upstream dams. Irrespective of their method of construction, all tailings dams constitute a substantial risk if they are not built, operated, monitored and maintained properly.

An established tailings dam is monitored using a variety of instruments, particularly piezometers, which measure liquid pressure in the dam, flow meters, which measure liquid movements in the sediment, and inclinometers, which measure the downward movement of the mass in a dam. Overall, such monitoring – correctly planned and executed – will provide vital information about a dam's stability.

When a tailings dam is first constructed, it is generally surrounded by an embankment made of compacted earth (starter dyke). In an upstream dam, when the level of the mass behind the starter dyke reaches a certain point, a new retaining embankment, dyke 2, is built inside (or upstream of) the starter dam, on top of the already deposited material. This process continues with new dyke levels being added as required. With each successive level, the dam face retreats further back. To prevent such a dam from collapsing, it is vital to place coarse particulate materials in the right places to allow the water to drain off. It is also important to insert drainage channels or pipes to carry away any surplus water. If fine-grained, clay-like sludge seeps into areas of coarse particulates, the draining properties of these areas will be reduced and stability may be impaired. It is critical that the dam's design is not deviated from, with respect to the positioning of unsaturated materials, ie materials in which the spaces between the particles are not saturated with water, and the saturated zone, ie an area where the spaces between the particles are saturated with water. With saturation, particles lose cohesion and the sludge will behave more like a liquid, which can create instability.

The risk posed by mine tailings dams is well known, and there have been several serious dam breaches worldwide in the past 20 years. In Europe, there have been serious dam breaches in Romania (2000)[7] and Hungary (2010).[8] In 2014, 10 million cubic metres of tailings were released following a dam breach at Mount Polley, Canada.[9]

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[6] About upstream dams: *This method, while available at low cost, implies a number of specific hazards for dam stability. These hazards require a thorough assessment and continuous monitoring and control during siting, construction, and operation of the dam. Experience shows that these conditions often are not maintained.* http://www.wise-uranium.org/mdas.html

[7] Baia Mare, Romania. Approx. 100,000 m^3 of cyanide-contaminated waste water ran out into a river, which caused extensive damage to the watercourse. http://archive.rec.org/REC/Publications/CyanideSpill/ENGCyanide.pdf

[8] Kolontar, Hunary. Approx. 700,000 m^3 of red slurry from the production of alumina flooded several villages after a dam breach. Ten people died. See, for example, https://www.theguardian.com/world/2010/oct/05/hungary-sludge-disaster-state-of-emergency

[9] Mount Polley, Canada, a copper and gold mine. Tailings spread out along the watercourses and caused substantial environmental damage.

The two dam breaches associated with Vale's iron ore production in Brazil are probably the two largest in the world in the past decade, both with respect to the number of lives lost and the volume of sludge that poured out.[10]

3 Scope and nature of the Council on Ethics' investigations

3.1 Mariana, 2015

Following Samarco's dam breach at Mariana in November 2015, BHP Billiton commissioned an independent investigation of the proximate causes of the collapse. The investigation was carried out by a panel of experts led by Norbert Morgenstern. The Morgenstern Report describes a long list of errors, going right back to 2009, when construction of the starter dyke was completed. [11] According to the report: "*Due to construction defects in the base drain, the dam was so badly damaged that the original concept could no longer be implemented.*"

The Morgenstern Report describes conditions at start-up in this way:

"*Engineering investigations later revealed serious construction flaws in the base drain and its filters, including a portion of the drain's outlet that had never been completed. This allowed water pressure within it to build until causing the slope to erode and slump.*

As these investigations continued, the impending rainy season made it too late to fully restore the drainage features to their original condition, making it impossible to repair the damage. Instead, all of the drains were sealed. With this, the most important element of the original design concept became inoperative."

The report goes on to describe structural faults identified in 2012. Actions to correct these faults led to new problems: "*With this, all of the necessary conditions for liquefaction triggering were in place.*" Fine-grained sludge seeped into areas where it led to increased instability, and parts of the area where unsaturated conditions were necessary to ensure stability became saturated. With reference to the three small earthquakes recorded about 90 minutes before the collapse, the report says: "*this likely accelerated the failure process that was already well-advanced.*"

All in all, the report points to some serious weaknesses in the dam's construction, maintenance of the drainage system and monitoring.[12]

Because the report was based on information from Samarco, all the factors relevant to the collapse that it refers to must already have been known to the company.

The scale of the damage caused by the accident was largely affected by the fact that the company, according to the authorities' final report, had no plan in place to deal with such incidents, nor even to raise the alarm in the form of sirens or warning lights.[13] Nor had the

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[10] http://www.wise-uranium.org/mdaf.html

[11] *Report on the immediate causes of the failure of the Fundao dam*. http://fundaoinvestigation.com/wp-content/uploads/general/PR/en/FinalReport.pdf

[12] Report: Mine tailings storage: Safety is no accident. https://gridarendal-website-live.s3.amazonaws.com/production/documents/:s_document/371/original/RRA_MineTailings_lores.pdf?1510660693

[13] From the report "*Avaliação dos efeitos e desdobramentos do rompimento da Barragem de Fundão em Mariana-MG"*

company put in place resources to block the progress of sludge in the watercourse. As a result, it continued flowing downriver until it ended up at the coast 17 days later.

UNEP summarised the harm caused as follows:

19 fatalities, 600 families made homeless, drinking water for at least 400,000 people contaminated, 1,469 hectares of forest destroyed, entire fish populations wiped out, 650km of rivers covered in sludge. The volume of sludge in the watercourse was so great that in the rainy season, when sedimentary disturbance is greater, metal concentrations in the water still rise to the level seen immediately after the dam collapsed.[14]

3.2 Dam 1, Brumadinho, 2019

No official reports have yet been published following the collapse of Dam 1 in 2019. However, some information on what the company knew before the dam breach does exist.

In connection with his Master's degree in geotechnical engineering, a Vale employee, Washington Pirete da Silva, wrote a thesis on the stability of the dam that collapsed in 2019. Da Silva's thesis was based on data supplied by Vale. The Council on Ethics has not seen the original thesis, but rests its assessment on an English summary.[15]

The thesis contains data indicating that the level of stability at the dam was extremely low. Samples of the sludge in the tailings dam were taken, and based on an analysis of particle size, it says: "*All samples tested indicate a potential for vulnerability to liquefaction, taking into account strictly the proportion and plasticity of the fines present.*" In a key paragraph, it says the following: "*…the susceptibility to or the potential for flow by liquefaction of these materials IS LIKELY*" (author's capitalisation). According to *World Mine Tailing Failures,*[16] for example, the calculated safety factors for the dam are only slightly higher than for a dam at imminent risk of collapse. Later, it says that the risk is nevertheless low due to a technically well-executed system and good operations, as well as a highly qualified technical workforce. The thesis contains limited data to substantiate this conclusion.

On 1 March 2019, the Brazilian prosecuting authorities and police published a document indicating that Vale had known the monitoring of the company's tailings dams was not satisfactory since at least as far back as 2017. An expert panel established after the Samarco collapse, in which Vale participated, pointed out that the method used to analyse laboratory samples was unreliable. It also recommended that the safety margins be raised. The weaknesses in the monitoring and risk management of Dam 1 were also impressed on Vale by a firm of consultants that assessed the dam at the end of 2017 at the behest of the company.[17]

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http://www.agenciaminas.mg.gov.br/ckeditor_assets/attachments/770/relatorio_final_ft_03_02_2016_15h5min.pdf referred to by UNEP, see footnote 14.

[14] Report: Mine tailings storage: Safety is no accident. https://gridarendal-website-live.s3.amazonaws.com/production/documents/:s_document/371/original/RRA_MineTailings_lores.pdf?1510660693

[15] Summary of Master's degree thesis, translated into English by Steven H. Emerman: https://worldminetailingsfailures.org/wp-content/uploads/2019/02/Corrego_Feijao_Thesis_Summary-steve-emerman.pdf

[16] See a review of conditions that affected the stability of Dam 1: https://worldminetailingsfailures.org/corrego-do-feijao-tailings-failure-1-25-2019/

[17] Recommendation by the prosecuting authorities and the police to Vale, 1 March 2019 (*Recomendacao)*: http://www.mpf.mp.br/mg/sala-de-imprensa/noticias-mg/Vale.pdf

Vale is obligated to have the dam approved by an external certification body. According to Reuters, which refers to an official document, Vale had originally purchased the certification service from the company Tractebel.[18] When Tractebel refused to approve the dam in 218, Vale released the company from its contract on the grounds of "*divergences in the criteria utilized to evaluate geotechnical* safety". Vale then engaged the consultancy TÜV SÜD, which approved the dam.[19] According to Reuters, the prosecuting authorities claim that Vale puts pressure on inspectors to approve dams that did not meet the technical specifications.[20]

TÜV SÜD already had a contract with Vale to assess the safety of the dam. On 20 August 2018, TÜV SÜD sent Vale a report on Dam 1 (*Technical safety audit 2nd cycle 2018 – Paraopeba Complex – Corrego Feijao mine – Dam 1,* original in Portuguese*).*[21] The report makes it clear that there are major problems with the dam.

The report states that it is not known or verifiable whether the dam has been constructed as it was planned. The report also points out that surface channels that were intended to lead water away had been trampled to pieces by livestock and that the majority of internal drainage pipes had also been trampled to pieces and were partly blocked. With respect to equipment, TÜV SÜD recorded that some of it had been installed upside down. According to TÜV SÜD, this mistake had been pointed out on a previous occasion, but had still not been corrected.

With respect to surveillance data, TÜV SÜD pointed out that considerable problems attached to measuring pore pressure in the dam. Conditions at the dam were monitored using piezometers, inclinometers, flow meters and other equipment. The readings from many of the piezometers were obviously wrong, but were impossible to correct, and many readings were unaccountably missing. Some readings showed values over the danger threshold.

Furthermore, TÜV SÜD asserted that it was not possible to compare water flow readings from the inside and outside of the dam, and that much data concerning this was also missing. The inclinometer data, which were supposed to show movements down in the deposited mass, were described as worthless. Upon inspection, it turned out that none of the inclinometers had been installed correctly.

The stability analysis that TÜV SÜD carried out indicated an extremely low level of stability, but there is some uncertainty regarding this interpretation.[22]

According to the newspaper O Globo, federal police officers have gained possession of email correspondence between employees at Vale and two other companies involved in the safety of Dam 1. The emails were written between 23 and 24 January 2019, in other words around a day before the collapse. The emails concern *discrepant data* from different automated monitoring instruments, and instruments (piezometers) that were not working.[23]

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[18] https://www.reuters.com/article/us-vale-sa-disaster/brazils-vale-fired-inspection-firm-that-failed-to-certify-dam-prosecutors-idUSKCN1QM080

[19] See the description of TÜV SÜD Brasil on the company's website: https://www.tuv-sud.com.br/br-en/about-tuev-sued/tuev-sued-brasil

[20] Reuters reports it like this: *"Prosecutors now allege that it was a 'recurrent practice' at Vale to pressure inspectors to sign off on reviews even if they «violated the required technical specifications."*
See https://www.reuters.com/article/us-vale-sa-disaster/brazils-vale-fired-inspection-firm-that-failed-to-certify-dam-prosecutors-idUSKCN1QM080

[21] Scanned copy of the report sent to Vale by TUV SUD, August 2018: https://worldminetailingsfailures.org/wp-content/uploads/2019/02/TUV-SUD-2018-Relat%C3%B3rio-estabilidade.pdf

[22] http://www.wise-uranium.org/mdafbr.html

[23] http://www.wise-uranium.org/mdafbr.html

It is not clear what kind of systems had been established to raise the alarm in the event of an acute situation, and whether there was an adequate response capability in place to limit the scope of the damage caused by any accident at the dams that failed. It is, however, clear that no evacuation was carried out or effective warning given at either Mariana or Brumadinho. In February 2019, after the accident at Brumadinho, Vale implemented routines to warn and evacuate at least four villages due to uncertainty about the safety of dams in Brazil, three at the Gongo Soco mine and one at the company's Mar Azul mine.

Following the accident at Brumadinho, the provincial government announced that it would demand the decommissioning of all upstream dams within a three-year period.[24]

4 Information from the company

The Council on Ethics contacted the company on 25 February 2019.

In its reply, dated 8 March, Vale states that it has a total of 148 dams in Brazil, of which 45 are tailings dams. 24 of these are in active use. A total of 9 are of the upstream type. Following the Samarco accident, Vale decided in 2016 to stop using all its upstream dams (at that time there were 19) and decommission them. So far, 9 have been decommissioned. The company also said: "*With the breach of the Brumadinho dam, Vale decided to accelerate the already planned decommissioning process of the 9 remaining upstream dams.*"

With respect to its follow-up of Dam 1 at Brumadinho, the company wrote: "*For the Dam 1 of Corrego do Feijão Mine, the last inspection registered on the ANM system was executed on 12/21/18. In addition, it underwent inspections on 1/8/19 and 1/22/19, and was registered on Vale's own monitoring system. The registration of each inspection on the ANM, according to legislation, must be executed by the end of the following fortnightly period. There were 41 water level indicators and 94 piezometers installed, out of which, 46 were automated. All these inspections did not detect any change in the stability of the structure. As a matter of fact, the water level inside the dam have been reducing over the last months (…)*"[25]

The company indicated on 26 April 2019 that it would comment on the Council's draft recommendation by the specified deadline, but despite additional prompting on the part of the Council, has failed to do so.

5 The Council on Ethics' assessment

On the basis of the information available, the Council on Ethics has considered whether there is an unacceptable risk that Vale SA is responsible for severe environmental damage as a result of dam breaches in 2015 and 2019. In assessments relating to the environmental criterion, the Council attaches importance not only to the environmental damage itself, but also to whether that damage has a significantly negative impact on human life and health. The Council has not assessed the company with respect to the human rights criterion, but would nevertheless like to point out that the consequences for human life and health in this case are of such a nature that they may also constitute human rights violations, including the right to life, safety, a home and clean drinking water.

[24] Referenced by the Wise Uranium Project: https://www.wise-uranium.org/mdafbr.html

[25] ANM stands for Agência Nacional de Mineração [*National Mining Agency]*, Brazil's federal mining industry regulator.

The starting point for the Council's assessment is that Vale, through its ownership, had decisive control over both the above-mentioned dams for several years before they collapsed.

The Council takes the view that the company is responsible for severe environmental damage. The basis for this opinion is that the damage caused in both cases was extensive and long-lasting. Large swathes of land have been permanently damaged, watercourses have suffered widespread devastation, whose effects will last for many years, and people and animals that depended on the water and river life have suffered severe and, in some cases, irreparable harm. The Council attaches particular importance to the fact that the dam breaches led to a major loss of human life. 19 people died in the Samarco accident, while at least 237 people died at Brumadinho.

In its assessment, the Council attaches considerable importance to the fact that the company, after a serious accident in 2015, failed to prevent a new accident with many of the same causal factors from occurring in 2019, with extremely serious consequences.

The Council notes that there are striking similarities between the two dam breaches, even though information about the dam breach at Brumadinho is still incomplete. As a result of extensive problems, neither dam seems to have been constructed in accordance with its original design. The monitoring of critical factors at both dams was extremely deficient and it has been documented that fine-grained materials had seeped into areas where this could compromise stability at both dams.

The report from TÜV SÜD, the expert panel in which Vale participated and the Master's thesis written by a Vale employee all show that the company knew there were considerable concerns about the condition of Dam 1. According to the Morgenstern Report, Vale also knew well before it failed that there were weaknesses in the Mariana dam that could affect its stability.

Despite an extensive volume of information about weaknesses in both its operation, maintenance and monitoring, and the collapse at Mariana three years before, the company had established neither an adequate emergency response plan nor an early warning system for indications of increased risk. Buildings for the company's employees were not relocated, but continued to be situated immediately downstream of Dam 1. Such a location, combined with inadequate warning routines, show that the company had not sufficiently taken into account the consequences of a dam breach in its implementation of risk-reducing and consequence-preventing measures. Many of the deceased were in this area and would not have been so badly affected if the buildings had been located elsewhere and an effective warning given.

When assessing future risk, the Council on Ethics attaches importance to the fact that Vale owns 45 tailings dams in Brazil. Since Dam 1 at Brumadinho was no longer being used, such that – in principle – no activity was taking place that could affect the risk to any particular degree, it should have been easier to prevent increased instability. The company's stated goal of discontinuing the use of all upstream dams does not therefore necessarily mean that the risk is reduced to an acceptable level, at least until they are entirely decommissioned.

Furthermore, the Council also notes that tailings dams not of the upstream type will also pose a safety risk if they are not followed up properly.

Finally, the Council on Ethics would like to point out that having inadequate prevention and early warning systems seems to have been a choice on the part of the company, which also indicates a future risk. This is also reinforced by the prosecuting authorities' claim that a certification body that refused to approve Dam 1 was replaced by another certification body.

The level of seriousness is further reinforced by the prosecuting authorities' claim that Vale had on at least several occasions pressured inspectors into approving defective dams.

6 Recommendation

The Council on Ethics recommends that Vale SA be excluded from investment by the Government Pension Fund Global (GPFG) due to an unacceptable risk that the company is responsible for severe environmental damage.

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