

## Learning from Chernobyl – a fatal reaction

### Context:

This article uses as its base the story of the world's worst nuclear disaster, when an explosion occurred at the Chernobyl nuclear power plant in April 1986.

Time to read: 10 minutes  
A full paper is also available



### Foreword:

*Risk management, and risk-informed decision-making, is about working out how to achieve goals and objectives. This piece is about watching for and guarding against dangerous negative patterns which, if they exist and if they are not acted upon, can lead to critical risks turning into catastrophic events.*

*Using the nuclear disaster of Chernobyl we discuss:*

- (1) aspects of organisational culture*
- (2) the importance of context to how and why risks are taken, and*
- (3) aspects of properly preparing for, and responding to, crisis events.*



## Introduction and Context

This article discusses how organisational culture and the ability to hold open discussions about risks are powerful factors that significantly impact our ability to manage risk and resilience. It uses, as a reference point, the events that led to the deadly nuclear explosion that happened at the Chernobyl Atomic Energy Station in April 1986, and how the situation was handled after it occurred.

The key points we discuss are:

1. You know how important culture is, so ensure you have a good one and nurture it
2. Be proactive to tackle critical weaknesses, don't wait till a major incident occurs
3. Be truly ready to respond to a crisis event – it's an important part of your culture

## An overview of the Chernobyl nuclear power plant

Construction of the Chernobyl nuclear power plant, in a boggy marshland area of Soviet Ukraine, began in 1970. Its four giant RBMK-1000 reactors (the name denoting that each such reactor was capable of generating 1000 megawatts of power) gradually came online from 1977 through to 1983.<sup>1</sup>

The Chernobyl plant (formally known as the VI Lenin Nuclear Power Station) was huge, and it was slated for expansion even whilst still being completed. By 1986, two additional reactors (on top of the existing four) were underway and scheduled for completion by 1987, to be online and connected into the power grid by 1988. If they had been activated, it is thought that Chernobyl would have been the largest nuclear power complex in the world at the time.

It is important to note that the Chernobyl plant gave rise to a brand new “atomgrad”, or “atomic city”, close by, called Pripyat which had a population of some 50,000 people based there, consisting of the workforce to serve it and their families.

It is also worth remembering that Chernobyl was just one of a dozen plants in the Soviet Union that used the particular type of reactor – the RBMK – that exploded so violently.

## A brief summary of what happened at Chernobyl...

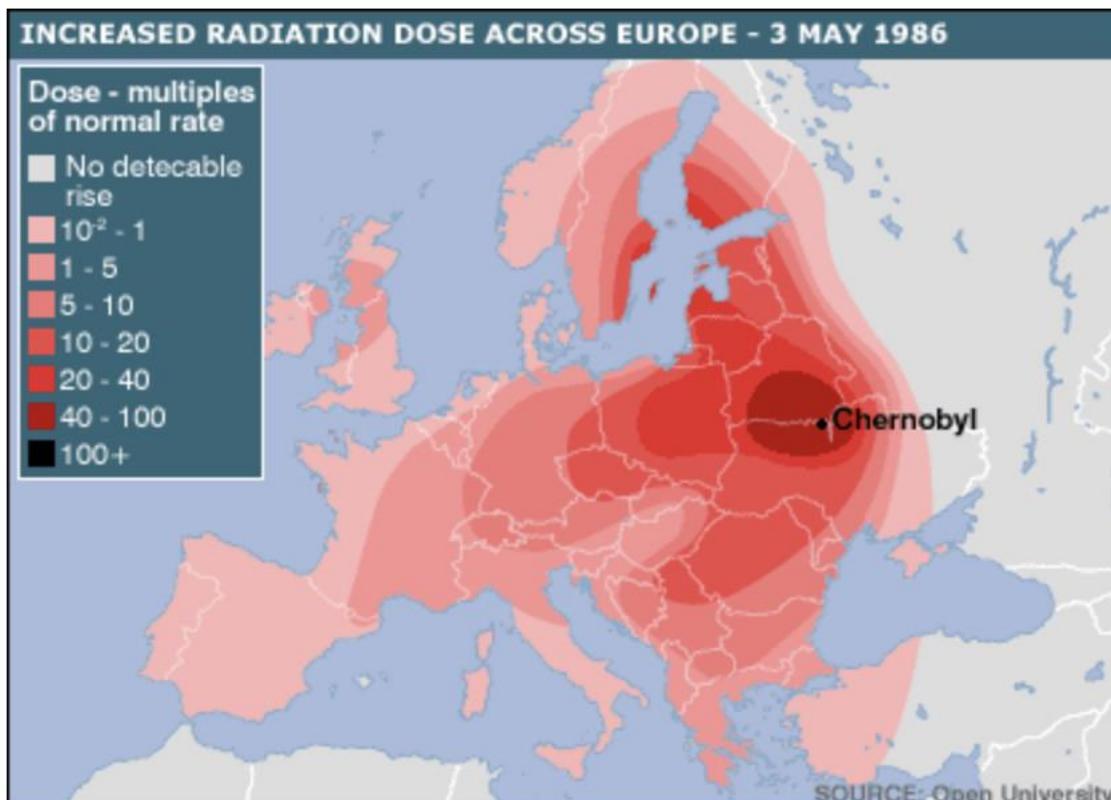
At 1.23am in the morning of April 26<sup>th</sup> 1986, unit 4, one of four giant [RBMK-1000](#) nuclear reactors (RBMK stands for *Reaktor Bolshoy Moshchnosti Kanalnyy*, or “High Power Channel-type Reactor” – a specific Soviet design) at the Chernobyl Atomic Energy Station exploded, releasing deadly radioactivity into the environment.

The devastating explosion at Chernobyl is one of the worst nuclear accidents in history. <sup>2</sup> It ended up contaminating over half of Europe with radioactive fallout. The steam explosion and fires released at least 5% of the radioactive reactor core into the atmosphere and downwind. One estimate has put the total cost for all elements of the disaster, over many years, to be in the region of US\$235 billion. <sup>3</sup>

The event caused multiple immediate fatalities. Officially, the official UN death toll of direct short-term deaths is 54. <sup>5</sup> Opinions on the number of deaths caused indirectly by the event over the long term – not to mention its effect on the environment, biodiversity and wildlife – vary. Some experts put it in the several thousands of deaths, so far. Refer to [this information from the World Nuclear Association](#) for more information.

Devastation was wrought unto the local area, including an eventual exclusion zone of 2,600 square kilometres (1,000 square miles) being imposed which is still in place to this day.

As well as this, the impacts were felt much further afield.



Today, many historical sources of authority see the disaster, and the unearthing of its true causes, as contributing to [the downfall of the Soviet Union](#).

## 1. You know how important culture is, so ensure you have a good one, and nurture it

Culture is more complex than describing it as “the way we do things”. Culture manifests itself in the actions and decisions that people make every day, on all matters, ranging from tactical to strategic. You see an organisational culture in full view when it has to deal with a tough and challenging situation, such as a crisis event. What happened at Chernobyl was, of course, a crisis event of huge international proportions.

We tend to think that we can easily recognise a bad organisational culture when we see and experience it. If this is the case, why do people often (indeed, usually) accept to work in such cultures? Sometimes we don't want to face it, sometimes a bad culture is not “sounded out” for fear of consequences that it may have on us personally (think of the [Tall Poppy Syndrome](#)).

Organisational culture was certainly an important factor contributing to the disaster at Chernobyl, and how people initially responded after the explosion first happened.

The World Nuclear Association [states their view as follows](#):

*“The April 1986 disaster at the Chernobyl nuclear power plant in Ukraine was the product of a flawed Soviet reactor design coupled with serious mistakes made by the plant operators. It was a direct consequence of Cold War isolation and the resulting lack of any safety culture.”*

### A review of aspects of culture that contributed to the disaster

Taking a broader view, on a broad, multi-country scale, the Soviet Union (USSR) operated as a bureaucratic ‘command and control’ authoritarian communist structure. Abundant committees led to diffuse and opaque accountability in all forms of State-wide decision-making (“*It's the State that requires us to do this*”). People in bureaucratic State positions were known as “the Party apparatchik”. Distrust was widespread – the KGB monitored every aspect of life – and there was little tolerance for dissenting views on what the State decreed was best for ‘the people’.

When reactor unit 4 at Chernobyl blew up in the early hours of April 26<sup>th</sup> 1986 and released deadly radioactivity into the environment, the most senior people at the Plant, including the Plant Director, Viktor Brukhanov, refused initially to believe the reactor had *really exploded*.<sup>4</sup> No one at the plant could believe it was possible, which was at least in part because they were not privy to confidential information about how an explosion of an RBMK reactor *could* occur in certain circumstances. Information about critical technical design weaknesses of the RBMKs was kept secret and classified by the State. Keeping dangerous secrets “locked in a vault” is one part of this dangerous cultural kaleidoscope.

Coupled with the problems inherent in the RBMK-1000 reactor design, which will be discussed in the second point of this paper. Human factors were a critical contributor to the explosion occurring.<sup>5</sup> A set of circumstances formed, stemming from the need

to perform a long-outstanding safety test that had failed in three previous attempts (the test was supposed to have been completed before the plant’s opening, but it was waived in order to meet a “politically-driven opening schedule”).<sup>6</sup>

Poor communication is another part of the kaleidoscope. The Plant Director didn’t even know that this safety test had been approved to take place that evening. His Chief Engineer, Nikolai Fomin, didn’t bother to tell him about it – nor did he inform the State nuclear authorities, or the reactor designers in Moscow.

### Examples of poor culture

Figure 2



### Black swans...?

Were the critical design weaknesses of the reactor an “unknown unknown” – sometimes known as a “black swan”, for people at the Chernobyl plant? The plant operators didn’t know what could happen to cause the reactor to explode, in the blink of an eye, in certain circumstances, because people in Moscow (the reactor designers, top Party apparatchiks and the KGB) covered this weakness up and expressly chose to keep it hidden. Was one group of people’s black swan event another group’s elephant in the room?

The design weaknesses were not due to a lack of technical understanding on the part of the designers. The design was implemented for economic reasons. Experts knew an explosion in this type of channel-type reactor could occur in certain, specific circumstances. They had data from previous accidents at other plants, and various tests, that revealed evidence which confirmed it.

Why was this important knowledge covered up? It links back to culture. The Soviet Union was obsessed with not admitting to any weaknesses in their “system”. They did not have the funds to build a more expensive, safer solution yet they needed/wanted to use nuclear power as an energy source across the Union. In risk management parlance, the risk appetite of those who knew about these grave technical weaknesses was that it was a risk that could be accepted in pursuit of their

objectives. What that says about their objectives, history has provided us with the answer. Presumably, a potential catastrophic scenario – with certain events linking together in a chain to cause an explosion in a reactor core – was considered and decided as not worthy to act upon to prevent it occurring. The technical designers and management were relying on human-managed critical controls – they did not systemise them. What ended up occurring when the chain of events took place and the reactor unit exploded was a situation of unprecedented complexity, with many factors combining at once to cause the disaster.

## Our take-away

In any workplace, we know that a culture where weaknesses are not admitted to and are covered up is bad. If a few people make one or more critical decisions and it or they are kept secret, for whatever reason, this secretive stance can come home to roost with bad consequences. A secretive culture leads to “elephants in the room”, which some people can’t even see are there. This can result in an inability to hold the right discussions at critical moments, about how to act and manage critical risks.

We have to accept that problems exist, to admit to our weaknesses and to work out how to act upon them. Our environments are complex and dynamic. Unwanted problems, situations and accidents can occur, and they can lead to crisis situations. We need to be open about what can cause such events, and review worst-case scenarios – using techniques such as Pre-mortem reviews – and strive for good resilience to prevent such events from occurring. There should be no risk appetite for situations that could lead to catastrophic events.

## 2. Be proactive to tackle critical weaknesses, don’t wait till a major incident occurs

There are a myriad of reasons why the known design problems with the nuclear reactors at Chernobyl were not tackled – and, it must be said, in other parts of the Soviet Union where the RBMK reactors were used, although at least the construction of new ones was halted after Chernobyl. There are still 10 RBMK reactors in use in 2019 (technical changes to them were made after Chernobyl disaster).<sup>7</sup>

In the case of the vast, sprawling Chernobyl power station complex, cost, budget and schedule drove decisions that meant critical controls to manage safety had critical problems and in-built design flaws.

There are many interconnected elements to this situation. Cost drivers explain, for example, why the four nuclear reactors at Chernobyl did not have an important “reactive control” of concrete containment structures surrounding each of them, which would prevent radioactive contamination escaping in the event of some form of serious accident, like an explosion, occurring. The sheer size of the RBMK reactors, due to their unique design, meant that building such containment structures would have roughly doubled the cost of each reactor unit. The risk appetite of the authorities was that it was a risk they were willing to take. Minimising cost was more important compared to the need to ensure safety at all costs. Was complacency a factor, too? Most probably.

The accident at Chernobyl drastically demonstrated that when certain conditions are present in high-risk activities and things line up that allow controls to be punctured, catastrophic consequences can occur – a classic example of the “Swiss cheese model”.<sup>8</sup>

A series of “holes” lined up that led to the explosion at Chernobyl occurring. The situation on the night shift in the early hours of April 26<sup>th</sup> 1986 was dynamic, with new factors introduced to the reactor unit 4 safety test. Warning signs were apparent as things were not proceeding to plan, yet people in the control room pressed on and catastrophic consequences resulted.

For those in Control Room Number Four at Chernobyl who were carrying out the reactor unit 4 safety test, it was by all accounts a stressful time. They were a nightshift crew that only found out they were to conduct the test when they arrived that evening (it had been scheduled to take place earlier in the day but was postponed, so that factories in The Ukraine could continue to draw maximum power from the plant to meet their monthly production quotas). The man in charge of the Control Room that evening, and the safety test, was known to be a difficult person to work with. As the night-shift technicians proceeded with the test, pushing the reactor beyond its safe operating limits, they didn’t know about the fatal technical flaw with the “scram shut-down button process”. (The “scram” process was supposed to be the “stop button” to cancel any operation.) Unbeknownst to them, the shut-down process would lead to the reactor exploding, due to the cauldron of conditions they had created inside it.<sup>9</sup>

## Our take-away

In any organisation or team (and as individuals, too), we have to act upon known weaknesses and problems, especially those that are genuinely critical. In some industries this is referred to as a “Maximum Foreseeable Loss”, or MFL.

If we do not act in such cases, the risk could become a major problem or crisis event, regardless of how well prepared we are to deal with it (be it a problem with a safety or environmental outcome, a financial outcome, or something else).

Various Risk tools and techniques exist (such as the bow-tie analysis, decision trees and quantitative methods) to help us unpack risks – to define causes, consequences and controls to manage a risk. They can only add value when we are able to use them for risks that we have identified, not risks that are “hidden away”, or that are “elephants in the room”.

For example:

- if we have known cost constraints on an initiative (which is often a fact of life) and these constraints are impacting our ability to achieve desired safety outcomes, we have to be prepared to talk through the problem with decision-makers, to look at scenarios of what could happen, including a worst-case scenario, to use our risk appetite guidelines, and to come up with the right, risk-informed solution that does not compromise objectives (which, in cases like this, must include safety).

- if we have known design risks or uncertainties, we have to think about the possible range of outcomes that could occur. Are we prepared to accept a worst-case scenario – is it within our risk tolerance (outside of our appetite)?
- if there are signs that sales pressures are driving certain behaviours that are not desirable, we have to act to stop the rot.

When we are in the midst of everyday operations, we need to maintain a mindset of constant vigilance, and to pay attention to subtle changes – because subtle changes could lead to different things happening. We need to focus on the “dynamics” of the situation, looking at what’s different today from yesterday or the day before – and it is especially true in complex environments. A checklist, whilst very useful in many circumstances, doesn’t show you the dynamics of the situation. Be watchful for these dynamics. Power and authority at “the front line” to stop things if risks are identified and seen as potentially problematic must be in place and be embedded into how the organisational or team culture works.

### 3. Be truly ready to respond to a crisis event; it’s an important part of your culture

In a culture where weaknesses are covered up and people cannot, or refuse to, act upon worst-case scenarios (as best they can, knowing that some external circumstances will be beyond their control), it is unlikely that good proactive response planning for crisis events will be in place.

When the explosion occurred at unit 4 at Chernobyl, the immediate response from the emergency services – and some people at the plant – was truly heroic. Tragically for those first responders, they were ill-equipped to deal with the magnitude of the situation facing them, and the extremely high radiation exposure levels that existed. Many fire fighters and first responders who bravely tried to tackle the perilous situation would die horribly painful deaths. They were not informed about or trained to deal with the dangers of radiation and the incredibly radioactive fragments that lay on the ground, blasted out by the force of the explosion. The controls in place to immediately respond to such a major radiation event were inadequate – ranging from poor knowledge, training and equipment of the team, through to inadequate Personal & Protective Equipment, or clothing, that was woefully incapable of protecting people in such a highly toxic radioactive environment.<sup>10</sup>

As mentioned earlier, the plant’s management refused to believe that the reactor core had exploded. Even when confronted with glaring evidence about it, such as chunks of graphite reported to be lying on the ground outside the reactor block, they could not believe it could have happened.

Research has since discovered that Prime Minister Ryzhkov told General Secretary Gorbachev and others in the Politburo in the months after the event that it was an accident waiting to happen – if not at Chernobyl, then at another RBMK reactor nuclear plant in the Union.<sup>17</sup> The endemic culture, as we discussed earlier, was poor.

## Our take-away

Crisis management is also about learning after the event, to improve. What was learned after the explosion, and what changed? Not enough, by all accounts, at least in the short term. Some 18 months after it occurred, in December 1987, unit 3 at Chernobyl was activated again (units 1 and 2 had come back online earlier). It was still a highly radioactive environment, and people were understandably reluctant to work there. Traces of uranium from unit 4 were still on the roof of unit 3. The three remaining Chernobyl RBMK reactors, along with twelve others in the Soviet Union, had been modified with extensive refits. Yet recommendations made by scientists for a major reactor design overhaul were rebuffed. Reports of minor accidents kept coming through. And at Chernobyl, workers were demoralised by how their deceased colleagues had been treated (some were made out as scapegoats).

In a good organisational culture, where people openly watch for concerns and risks and “air them openly with each other and decision-makers”, and where weaknesses are examined and acted upon, there is a willingness to take proactive action to be ready to respond to major incidents or events if they occur. Nobody wants bad things to happen, but we should be ready to respond in an effective way if they do. This includes many aspects of control design, implementation and verification, from setting up a response team structure with trained people (and delegates) who know what to do in specific situations, to engaging experts to help you with specific parts of the response, including having a well-thought-through crisis communications plan.

A framework to understand critical risks, and how to effectively detect and respond to “risks that become crisis events”, equips you to know how and when to quickly activate good crisis and emergency response plans to deal with such an event, with safety, health and the environment always being the primary concern. Whether you operate to the principles of a [High Reliability Organisation](#) (HRO) or you work to other good practices, being ready to respond at any time to a crisis event is part and parcel of a good organisational culture, and it is closely linked to good risk management.

## Conclusion

In this paper we have sought to identify some key learning points about risk management, crisis management and culture from what happened at Chernobyl.

For risk management and crisis management to be working well in an organisation, it's vitally important for the following:

- To have a good, clear and open culture in place;
- To ensure people feel empowered to flag, and admit to, weaknesses;
- To being proactive to address these concerns and weaknesses;
- To avoiding the trap of “it won't happen to us”;
- To being properly ready to respond to a crisis event if it occurs.



## References

- 1 Midnight in Chernobyl, p. 22
- 2 The World Nuclear Association [summary of the Chernobyl accident](#)
- 3 UNDP [paper on Chernobyl](#)
- 4 [Wikipedia and UN](#)
- 5 Midnight in Chernobyl, p. 105
- 6 The World Nuclear Association [summary of the Chernobyl accident](#)
- 7 Midnight in Chernobyl, p. 20
- 8 [Live science website](#)
- 9 [Wikipedia](#)
- 10 The World Nuclear Association [summary of the Chernobyl accident](#)

## About the author

Gareth is Principal Consultant at Risk Insight Consulting and a Director of Satarla Australia.

## Examples of further information about the Chernobyl disaster

[World Nuclear Association information on Chernobyl](#)

[Midnight in Chernobyl](#) (by Adam Higginbotham)

[An interview with Adam Higginbotham](#), author of Midnight in Chernobyl (YouTube)

[Chernobyl: History of a Tragedy](#) (Serhi Plokyh)

[Voices from Chernobyl](#) (by Svetlana Alexievich)

[The Chernobyl disaster: 25 years ago](#) (The Atlantic, March 23, 2011)

[The IAEA News section on Chernobyl](#)

[A description of radiation levels from Chernobyl](#), including a Met Office animation showing the spread of caesium released in to the atmosphere

[What we can learn about Human Risk from my new favourite TV show](#) – an article by Christian Hunt (Human Risk)

[The HBO Chernobyl TV mini-series](#) + Podcast (HBO) – note that this is a drama series, in which some parts of the story do not represent what actually happened (the Podcast helps to explain and provide context)

[HBO's Chernobyl carries a chilling warning for our times](#)

[Visiting Chernobyl – what to do and what not to do](#)

[Are we too scared of nuclear energy? BBC Business Daily podcast \(July 2019\)](#)