Dr Christina Baxter, of EmergencyResponseTIPS.com, is joined by a special guest to relook at old cases

Lessons Learned: Chernobyl

The purpose of the Lessons Learned series is to reconsider historical events from a fresh perspective and see how response objectives would be different today, with added knowledge from past events and the inclusion of new technologies. In this issue, we focus on the lessons identified following the 1986 Chernobyl disaster. This accident had significant global implications, and remains one of the largest historical events that can be reviewed when planning for the future.

The Chernobyl Nuclear Power Plant (NPP) accident on 26 April 1986, was the result of a flawed reactor design that was operated with inadequately trained personnel and an irresponsible approach to nuclear energy management at local and ministry levels. It involved the largest uncontrolled radioactive release ever recorded for any civilian enterprise, and large amounts of radioactive substances were released into the air over about 10 days. Activity continued at a lower rate for a few months after the initial release, and contaminated a huge area around the NPP, even dispersing to surrounding countries.

Yaugen Ryzhykau, CEO of CBRN Protection TCT, who was part of the team that deployed provided some answers.

The firefighters of the facility station were the first emergency responders on site after the accident, and their role was critical and multifaceted. They demonstrated group heroism in controlling the fires caused by the exploding reactor and prevented further damage, despite poor general planning, imperfect equipment, training and logistics, and non-fulfilment of emergency response standard operating practices (SOPs). They faced health hazards during the work, especially on the roof of the machinery hall and exploded reactor. Had they not extinguished the fire in the reactor and machinery building immediately after the explosion, the spread of fire to the electrical generators in the machine hall and the roof of reactor three could have led to a stoppage and similar accidents at the second or third power unit. The disaster would then have gone global.

They played a significant role in establishing safety perimeters and control zones around the disaster site, contributing to overall containment. Their immediate experience also assisted in the decision to evacuate nearby residents minimising their radiation exposure.

Some 530,000 military and civilian specialists and non-specialists participated in on-site activities at Chernobyl NPP. By mid May 1986, 30,000 troops had been dispatched including nearly 13,000 specialised NBC soldiers and specialists from military R&D installations.

The government commission assigned all urgent tasks to the operational group (OG) of NBC troops. Tasks included monitoring emissions from the damaged reactor, organising decontamination of NPP buildings, structures and territory, populated areas, transport, and roads, along with dust suppression, and collection, removal and disposal of high-level waste near the destroyed reactor.

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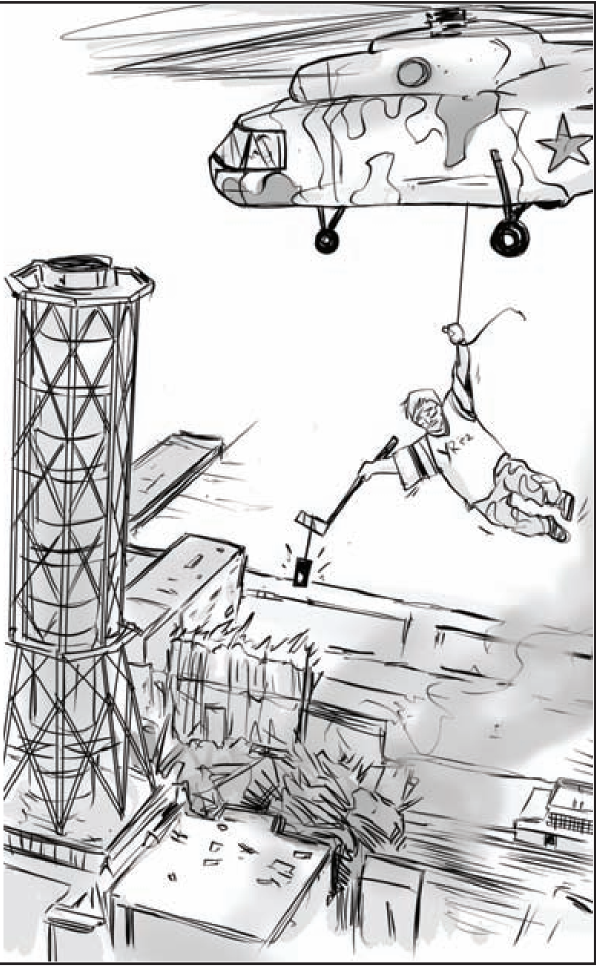
I was a 30-year-old captain/scientist researcher and my lab equipment was related to aerosol dynamics and measurement of air and sediments. On 4 May 1986, I was ordered to support the mission of a group of scientists from the Leningrad Radium Institute. We were tasked with establishing how much and what kind of radioactivity was being released, the temperature in the hottest part of the destroyed reactor and how much of the radioactivity already released had contaminated the surrounding area for a distance of 30km (18.6miles).

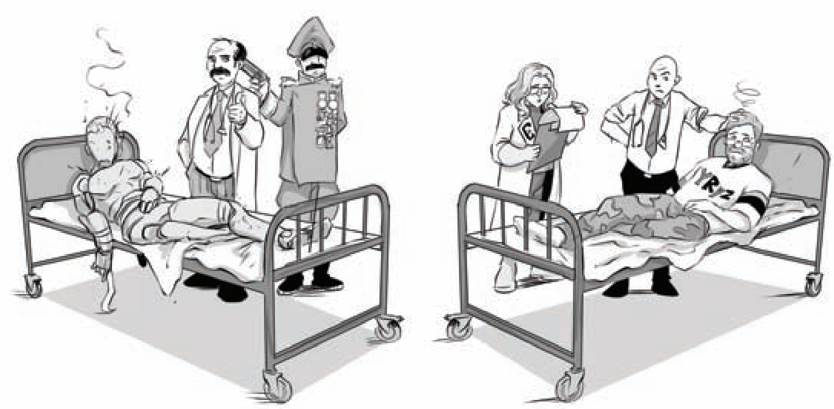
We had to take samples directly from the emission plume at its nearest point to the reactor. This could only be done by helicopter as the level of radiation on the buildings and around the reactor was lethal. From 7 May, we made regular helicopter flights to the reactor to take radionuclide samples from the plume. While working at the NPP, I had to fly over the destroyed reactor nine times in five missions.

I also had to approach the reactor building four times to take air and soil samples. Previously this was done at high speed by NBC troops in a 'Cashalot' vehicle. My role was to make 10 stops at various points and take air and soil samples over three minute periods using a portable sampler, while avoiding fragments and splinters from the reactor fuel assembly. This was extremely dangerous, with radiation levels ranging from 0.5 to 20Sv per hour at different points.



I took all the air and soil samples to the Radium Institute's stationary radiological laboratory for sample analysis and reported the results to OG. It was a 'hot time' period, working up to 20 hours a day.

Due to our analysis a dangerous operation to build a tunnel under the destroyed reactor was abandoned. Evaluation of our samples showed that only about a ton of fuel had been released from the reactor across the station as a whole, the rest had been scattered over an enormous surrounding area.



In terms of lessons learned:
Radiation awareness: In many cases, first responders were not adequately informed about radiation hazards. Medical doctors would record readings from the ID-11 dosimeters but cover up the true doses. Under the unblinking gaze of the KGB, the doctors would reduce our received doses in order to stay under the maximum cumulative radiation of 0.25Sv for the whole working period in order to prolong the duration of on-site operations.

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Monitoring and assessment tools: Firefighters did not have appropriate assessment tools to understand the radiological situation on the spot. Specialised units were also deployed without personal radiation dosimeters. All dosimeters had been sent for regular checking and certification two days before the accident, so no spares were available!

Radiation protection training: Except for specialised military units, no civilian, paramilitary and/or military units were appropriately trained. Most first responders did not work effectively and were exposed to radiation above established limits, developing serious health problems afterwards.

Incident command structure and interagency coordination: On arriving at Chernobyl, we met only chaos, disorganisation, frustration and lack of coordination. The military unit was initially located next to the NPP, then moved 30km away, but with tents which had already accumulated a lot of radioactive dust with an ambient radiation level exceeding 30 µSv/h!

Tasks were not always coordinated with other departments, such as the NPP's management, or clean-up teams. This led to the team's unnecessary overexposure. For example, investigation of reactor condition using military 'biorobots' from unit 122 was done while the air force was 'bombing' the reactor with boron and lead. Concreting of the area around the reactor, in order to prevent dusting and reduce radiation levels, was done without coordination with plant management, resulting in a lack of access to the sub-reactor space.

Protective equipment, hygiene and logistics: Protective measures were taken sporadically or not at all. I received neither potassium iodine nor basic protection gear upon arrival, and was pushed onto my first mission to the exploded reactor in my military uniform without a respirator. Changes of protective gear were not provided at the NPP, and personnel were forced to return to the tent camp in dirty gear after working at the NPP. Meals were often provided in an open area!

Public communication: It's well known that Soviet leaders tried to hide the truth about the accident from their citizens and the international community. Dissonance between reality as seen on site and propaganda on TV ruined trust in the Soviet regime.

If I'd known then, what I know now…, I'd plan a response for the full range of possible disaster scenarios, including multiple and simultaneous ones. The responsibilities of national institutions, agencies and actors must be identified, set and agreed upon within a planning, preparation, response and recovery strategy. The necessary financial resources must be allocated within regular budget programmes. All equipment required for responders must be stockpiled, maintained and replaced periodically according to the SOPs for worst case scenarios. Conduct regular exercises and training programmes for command and control centres at all levels of management as well as first responders. Use only well-trained responders during a disaster. Arrange effective radiation exposure control on site and ensure safe operations as far as possible for first responders.

The need to preplan and test those plans has been highlighted by the response to the Chernobyl incident. Today's plans must address incident management such as, roles and responsibilities, access to subject matter expertise, dose limits, site management and isolation, detection and monitoring, PPE, decontamination, medical countermeasures and public information.

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Training and exercises. Responders must understand the threats in their jurisdiction as well as those in neighbouring jurisdictions and must train and exercise to meet these threats. Importantly, this includes incorporating incident command for large scale events and radiation awareness for responders. It remains true even decades after the event.

As was also demonstrated at Fukushima in 2011, these events may take years to resolve, yet most exercises don't address events that go on for days, weeks, months or years, so there's little experience in long term communications, coordination, logistics, staff turnover and more. Continuity, leadership transitions, long-term logistics support, and finance must be considered during these longer term events.

Detection and monitoring. Prior to any incident agree on approaches to field sampling and surveying, and operational dose constraints, in coordination with radiological SMEs as well as measurement units, conversions factors, and interpreting results. Also preplan standardised levels for control zones and action levels at each incident site. Once these matters are agreed, contamination distribution mapping can be done using interagency teams incorporating radiological SMEs. With sensor platforms now integrated into unmanned aerial and ground vehicle platforms, it is no longer necessary for operators to move forward into contaminated areas of high exposure risk. This data is wireless and securely delivered directly to inform data analysis, plume verification, asset tracking and situation awareness.

Protection. Detection and monitoring data should be used to minimise responder exposure, while decontamination approaches select and assess the success of community protective actions. The use of radiation dosimeters allows responders to track their dose profiles and manage their total doses over time. In parallel, preplanned medical countermeasures are critical and their distribution must be practiced during exercises. This practice should also include decontamination, hygiene, heat stress, work-rest cycles, and ways to minimise responders' total exposure.

Public Communications. This is critical to the successful resolution of any event. While the USSR's leaders were not forthcoming with information during the Chernobyl event, communities expect to be informed. Current technologies allow for the delivery of visual aids and maps containing near real time data showing contamination levels and locations. Coordinated and consistent data messaging is critical to successful public protection strategies.

As always, ensure that your plans are contemporary and include all partner agencies before you need to engage them. Practice tactical, operational and strategic actions to minimise pitfalls during an actual operation.

Images are courtesy of Phil Buckenham https://philbuckenhamart.wixsite.com/philbuckenham

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