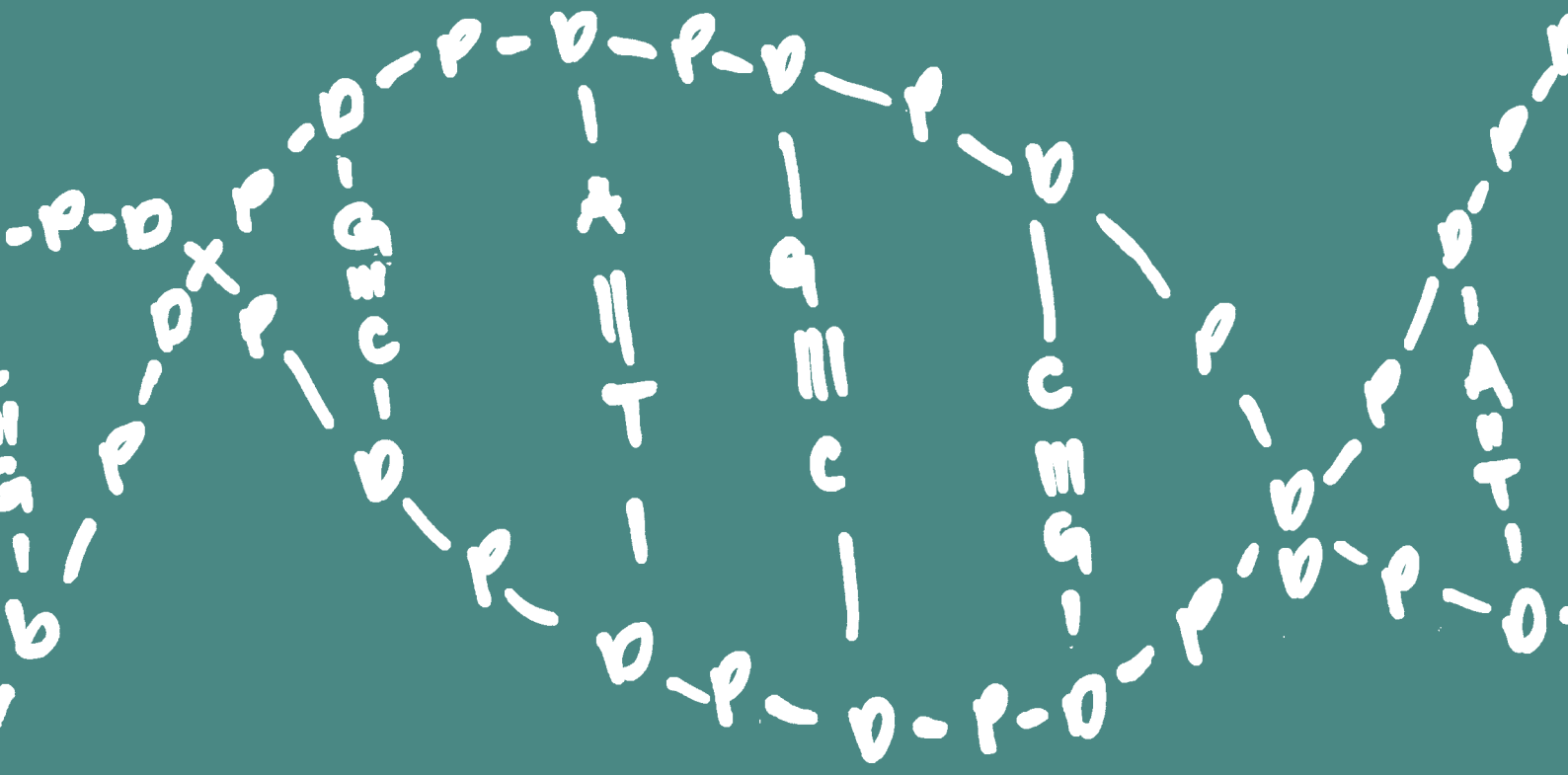
Annual Report 2022

Spiez Laboratory



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SPIEZ LABORATORY

Imprint

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This Annual Report is also available in a German/French version.

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May 2023

Dear Reader,

Dr Marc Cadisch
Director Spiez Laboratory

After two challenging and intensive pandemic years, we at Spiez Laboratory presumed that in 2022, our focal topics would again take a back seat in the public eye. As a specialist institute, we like to focus on our core mission: the development of scientific and technical foundations for NBC protection. Unfortunately, another major development has once again required us to redirect our attention. The Russian attack on Ukraine has abruptly put power-political threats back at the centre of the security policy debate. After the end of the Cold War, the protection of the population in the event of a military conflict took a back seat; civil protection became primarily concerned with managing disasters and emergencies. Recent events in Ukraine have unfortunately made it clear that this assessment was flawed: war remains a reality – also in Europe.

This new reality has a major impact on our responsibilities in NBC protection: Russia has also taken the conflict to the international arms control bodies, making false claims about biological and chemical weapons programmes in Ukraine. Together with other states, Switzerland is working all the harder for constructive developments, an example being the “Arms Control and Disarmament Strategy 2022–2025” adopted by the Federal Council in 2022 – to which Spiez Laboratory is making important contributions. With the threat to use nuclear weapons, Russia’s President Putin has also triggered fierce reactions in politics, authorities and media worldwide. Questions about the state of preparedness for a possible nuclear threat have suddenly become highly topical again. All this also affects Spiez Laboratory: we contribute our expertise

for the benefit of partners in the authorities, in international organisations and the public. For example, in 2022 on behalf of the UN Environment Programme (UNEP), we trained Ukrainian experts in Switzerland to conduct environmental assessments (see report on p. 8) and we provided NBC surveillance for the Ukraine Recovery Conference in Lugano (see report p. 6).

Latest developments have made one thing clear: protecting the population from NBC threats is a central security task, today and in the future. In this annual report you will find a selection of projects we worked on last year. They all serve our fundamental goal: to contribute to peaceful development and greater security – for the Swiss population and the international community alike. I wish you a stimulating read.

Mario Burger, Senior Nuclear Scientific Advisor of Spiez Laboratory, discussing nuclear issues on Swiss television.

Operational vehicle of the DDPS emergency response team (EEVBS) in front of the Lugano Convention Centre

01

CBRN surveillance at the Ukraine Recovery Conference

In order to ensure CBRN protection at major events, Spiez Laboratory has specialists, highly sensitive measuring equipment and dedicated emergency and monitoring vehicles at its disposal. In recent years, precautionary measurements at conferences and major events have increased in the area of nuclear protection. The missions are carried out in cooperation with the National Emergency Operations Centre, the responsible canton, and the relevant federal agencies such as fedpol or the Federal Intelligence Service.

Markus Zürcher

The Ukraine Recovery Conference (URC2022) took place in Lugano on 4 and 5 July 2022. Two weeks earlier, the Ticino cantonal police submitted an official request to the Federal Office for Civil Protection (FOCP) for precautionary monitoring of radioactivity (R-/N-protection). We were able to respond positively to the request. The National Emergency Operations Centre (NEOC) was responsible for the overall coordination within the FOCP, while Spiez Laboratory and the DDPS Operations Team (EEVBS) were in charge of on-site operations.

In the run-up to the conference, we worked with the Ticino cantonal police and the organiser to determine the parameters for the operation at the Lugano Convention Centre. Together with the

Federal Office for Customs and Border Security (FOCBS), we undertook radioactivity measurements at various locations in the canton of Ticino. The NBC-EOD Centre of Competence supported us with an additional measuring vehicle.

The R-/N-protection of the conference was ensured throughout the entire event directly at the venue. For this purpose, we deployed highly sensitive measuring devices that discreetly and inconspicuously ensured the safety of the conference guests. In addition, fixed radioactivity measuring probes were installed in the immediate vicinity to enable a rapid assessment of the radiological situation by the NEOC in the event of an incident. Precautionary measures following a major incident involving radioactive substances were planned in advance with the Ticino cantonal police. Radiological protection of emergency personnel was ensured by means of personal dose monitoring.

In order to be able to intervene quickly in the event of a C or B threat, appropriate EEVBS specialists and intervention resources were deployed to the site. The EEVBS was supported by cantonal agencies, who provided their infrastructure in the form of emergency vehicles and material available. This ensured rapid and targeted interventions also with regard to these threats in the Lugano region.

The deployment of the C-EEVBS was also used for training purposes. This enabled staff from Lugano's professional fire brigade and other cantonal agencies to exchange experiences with our technical specialists, thus improving the conditions for further cooperation.

Discretion was a challenge during the radiological measurements in the Convention Centre. All the specialists from Spiez Laboratory worked in civilian clothes and were equipped with means of communication. The measurements had to be undertaken without any gaps whilst ensuring that the conference participants were not disturbed or hampered. In the event of an alarm, rapid intervention is required without attracting undue attention. To this end, the EEVBS head of operations was in constant contact with the cantonal police and was informed by them in advance about special daily routines.

The conference proceeded without any noteworthy CBRN incidents. Suspected cases reported by the cantonal police were quickly clarified and technically cleared. Despite the sometimes very high temperatures outside, all measuring devices and systems functioned faultlessly.

We would like to thank all the partners who supported the successful CBRN monitoring at this conference.

The presence on site was also used for training purposes. This enabled the professional fire brigade Lugano to gain experience with the specialists from Spiez.

02

Contaminated Site Assessment Training Workshop for Ukrainian Environmental Experts

The Russian war of aggression against Ukraine is causing massive environmental damage. Russia is shelling Ukrainian infrastructure and production sites, causing toxic poisonous substances to contaminate air, water and soil. Spiez Laboratory, in cooperation with UNEP, organised a training course on investigating and managing environmental damage for Ukrainian experts in November 2022.

Smoke rises above the Azovstal iron and steelworks in Mariupol. It is the first time in Europe in a long time that fierce fights are taking place in a heavily industrialised country.

Marc Stauffer

Research by the Ukrainian government, the United Nations Environment Programme (UNEP) as well as several non-governmental organisations has shown that the war is causing massive pollution of the air, water and soil. Toxic chemicals and hazardous waste are among the most important environmental problems of the conflict, especially in terms of immediate risks to human health. Nuclear facilities and radioactive material storage facilities have also been affected by the war. Combat operations have affected key infrastructure including water supply, sanitation and energy. Industrial facilities such as mines, fuel depots and transport infrastructure, as well as residential and government buildings have been damaged. Shelling of military installations caused significant contamination with heavy metals and explosives and their residues. Contaminated site assessment training is therefore central to assessing the environmental impacts of the Ukraine conflict.

Shortly after the outbreak of the war in Ukraine, the Ukrainian government approached the United Nations Environment Programme (UNEP) with a request for support. Spiez Laboratory has a long-standing cooperation with UNEP for the assessment of environmental damage after armed conflicts – such assessments also enable us to optimise our own capabilities in the field of environmental assessments. This commitment helps to adapt our own scientific-technical knowledge to new developments, it provides concrete experience in the field and it allows training with real samples.

UNEP's long experience in post-armed conflict environmental pollution investigations (e.g., in the Balkans, in Iraq, Palestine and Nigeria) has shown that tailored training programmes on key issues are the most effective approach for transferring knowledge on environmental assessment methodologies. In conflict situations, such assessments need to be carefully tailored to the context and objectives of the study in order to be of practical relevance. Therefore, from 21 to 25 November 2022, a jointly organised training event for 23 Ukrainian experts took place at the Federal Training Centre (FTC) in Schwarzenburg, under the title "Ukraine Contaminated Site Assessment Training Workshop".

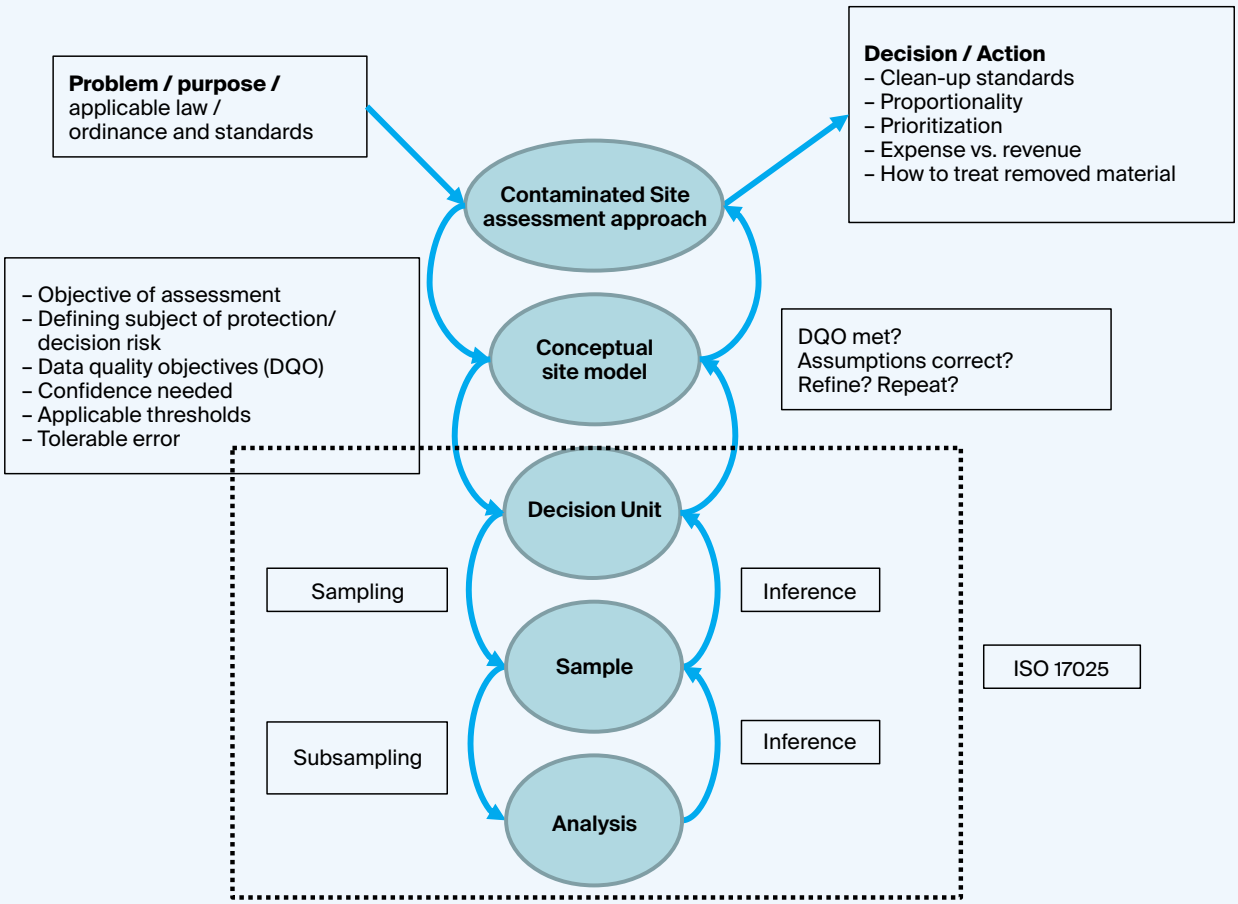
Workshop program

The workshop covered all relevant activities and procedures related to the investigation of polluted sites. Figure 1 shows the sequence of the different work steps that usually have to be followed. These steps were taught as individual modules during the workshop.

A robust and reliable conceptual site model (CSM) is the basis for a scientific, risk-based assessment of contaminated sites. It is important for making future decisions on remediation measures. The CSM involves the formulation of a contamination hypothesis based on a source-exposure pathway-receptor analysis to identify risks to human health and the environment.

Sampling strategies and procedures are considered the "weakest link" in the assessment of contaminated sites (more than 75% of the total error of the procedure is caused by sampling errors). Key elements include firstly the decision unit and secondly incremental, probabilistic sampling. This means that a sample is composed of many small increments. Decision units are primarily physical or spatial units of land, water bodies, dumps, etc., which are usually delineated based on the risk assessment determined in the standard model. Incremental sampling ensures that the samples taken are representative of the target area and the mass/volume of the material. This makes sampling reproducible. While expert judgement may be used to determine decision

Figure 1



units based on the standard model, the sampling procedure should be probabilistic and not determined by individual judgement to allow confidence-based decision making.

One of the main focuses of the course was therefore the theoretical basis of Pierre Gy sampling[1] and the determination of the required mass and an appropriate number of increments in defined decision units. This is done to capture the distributional heterogeneity and to estimate the individual components of the sampling error as well as the confidence level. Following an incremental sampling approach also has the advantage of significantly reducing the costs of laboratory testing by reducing the number and mass of samples.

The size of the sampling error can be used to assess the quality of the sampling plan and to determine whether the protocols used and the decisions made are scientifically defensible. By estimating the sampling error before the field campaign, it is possible to control the error and reduce it to an acceptable level by implementing appropriate measures. This procedure is important in order to be able to scientifically defend the basis for decision-making.

After the practical implementation of planning and sampling, the analysis was presumed conducted in the exercise and the results submitted in the form of a test report. With the data obtained, the course participants were tasked to back-calculate the data obtained to the decision units of their scenario and statistically assess the results obtained.

The choice of remediation method for contaminated sites depends on: (i) the type of contaminant, (ii) the physical characteristics of the site, (iii) the available technology, and (iv) the cost and affordability. Internationally, there are more than 30 different techniques for remediating contaminated soils and waters, which can be broadly divided into biological and non-biological methods. There is no patent remedy for contaminated site remediation and usually a combination of technologies must be used in conjunction with each other.

What comes after the training?

The training in Schwarzenburg provided a good opportunity for participants from Ukraine to meet for the first time since the outbreak of war and to share their methods and plans. At the same time, it was recognised that a pragmatic approach to contaminated site assessment needs to be tailored to the context of the armed conflict in Ukraine. A set of minimum standards need to be adhered to, however. This is important to ensure the reliability and defensibility of the results. It was also suggested that personnel involved in environmental site investigation need regular training to improve their skills and keep abreast of the latest developments in site investigation methods and technologies.

The course participants proposed several measures to build additional capacity for environmental analysis, including:

– Establishment of a working group for the assessment of contaminated sites with the involvement of workshop participants, to be chaired by the Ukrainian Ministry of Environmental Protection and Natural Resources. This working group would help coordinate pollution assessment activities, especially with international partners interested in supporting this area of work.

[1] Francis F. Pitard (1993) "Pierre Gy's Sampling Theory and Sampling Practice", CRC Press LLC

- Reconnaissance visits to 1–2 sites that are safe and accessible. Methods learnt should be applied as far as possible under the given circumstances.
- Further in-depth training on specific topics, including hydrocarbon pollution with a focus on the marine environment, radiation exposure, laboratory analytical procedures and laboratory accreditation requirements, risk assessment and modelling, or remediation of contaminated sites.
- Reviewing the status of accredited laboratories in Ukraine, including their compliance with international standards.
- Provision of monitoring equipment and in particular portable equipment to support environmental site investigations.

The training in Schwarzenburg gave the participants from Ukraine the opportunity to meet and share their plans for the first time since the outbreak of the war.

03 «Determined for the sake of all mankind ...»

Address by Stefan Mogl, Head of the Chemistry Division at Spiez Laboratory, delivered on 29 April 2022 in Berlin at the launch of the Competence Network CBWNet to strengthen the norms against chemical and biological weapons, on the occasion of the 25th anniversary of the Entry into Force of the Chemical Weapons Convention (CWC).

Efforts to ban chemical weapons

The Strasbourg Agreement

The first international agreement limiting the use of chemical weapons dates back to 1675, when France and Germany came to an agreement, signed in Strasbourg, prohibiting the use of poison bullets.

The Hague Convention

Contracting parties declared their agreement to 'abstain from the use of projectiles, the sole object of which is the diffusion of asphyxiating or deleterious gases'.

The Geneva Protocol

The 1925 Protocol for the Prohibition of the Use of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare, commonly known as the 1925 Geneva Protocol, bans the use of chemical and bacteriological (biological) weapons in war.

1675 › 1899 › 1925

Stefan Mogl

Excellences,
Dear Ladies and Gentlemen,

Thank you for your kind invitation to the launch of the Competence Network CBWNet (www.cbwnet.org) today – on the 25th anniversary of the Entry into Force of the Chemical Weapons Convention. It is an honour to be speaking here together with such highly esteemed disarmament experts.

The invitation contained three questions:
- Why is the CWC so successful?
- What challenges lie ahead?
- and How unity in the international community can be strengthened in dealing with treaty violations?

I am confident that you do not expect me to answer the questions comprehensively in 15 minutes, but I will try to explain my perspective to you.

The Chemical Weapons Convention

The Chemical Weapons Convention opened for signature in Paris on 13 January 1993. Within the first two days, 130 nations signed the Convention.

1993

OPCW

On 29 April 1997, history was made with the entry into force of the Chemical Weapons Convention – the world's first multilateral disarmament agreement, which provides for the elimination of an entire category of weapons of mass destruction within a fixed timeframe.

1997

Nobel Peace Prize

In recognition of its extensive efforts to eliminate chemical weapons, the OPCW was awarded the Nobel Peace Prize.

2013

„Determined for the sake of all mankind, to exclude completely the possibility of the use of chemical weapons, through the implementation of the provisions of this Convention ..."

You will recognize this quote from the Preamble of the Convention. I read it for the first time in 1994, before submitting my application as OPCW Inspector. While I would not call the Convention a "page-turner", these words still touch me to this day, and I use them to frame my remarks.

Why is the CWC so successful?

One simple answer is, because of its objectives. Helping the world to destroy Chemical Weapons and making sure they will never be used again is a noble cause. A cause that motivates countries to join and people from around the world to dedicate many years of their professional life aiming towards this goal.

But this does not explain, why the OPCW Technical Secretariat – who is responsible for implementing the provisions of the Convention – has been so successful for 25 years!

Allow me to take you back a few years to January 1997. Approximately 150 scientists from over 60 countries met for the first time in The Netherlands to embark on a five months training program, after which they would become the first OPCW inspectors, called inspector Group A.

Analytical chemists, chemical logisticians, industrial chemists and weapons experts from around the world came together in The Hague to put the text of the Convention into operation. But how should things be done in practice? How to count chemical munitions in storage facilities? How to monitor destruction facilities in order to prevent diversion of chemical weapons: which doors should be sealed, where should cameras be placed, which areas needed continuous observation and which ones could be visited by inspectors at random? How to inspect chemical industry facilities: how to verify that a chemical plant is not producing prohibited or undeclared chemicals; how to review company records? Should inspectors ask for samples, and how should they be analysed? How to protect companies from losing proprietary information during sample analysis? All these questions and many more required practical answers. They were developed by the staff of the Technical Secretariat until all parties were satisfied – inspectors, verification officers and Member States representatives. The "How-To-Do Things" was then documented in Standard Operating Procedures, Guidelines and facility agreements.

The Secretariat could count on science advice early on. The OPCW Scientific Advisory Board became operational in 1998 and today composes of 25 esteemed scientists from around the world. The Board answers questions from the OPCW Director-General, and informs the Review Conference about relevant developments in Science and Technology. The Board is not static; its members change every six years to ensure new thinking.

Also in 1998, the OPCW Director-General designated the first laboratories for offsite analysis of samples. Ever since, the OPCW has relied on a network of

laboratories from around the world – today there are 22. They demonstrate their competence annually in highly challenging proficiency tests and are today the most competent laboratories for chemical weapons analysis.

One last example before I make my point: shortly after the beginning of the New Millenium, the Technical Secretariat, as the first Multilateral Organisation, received an accreditation by the Dutch Accreditation Council as Testing Laboratory under ISO 17025 – a landmark achievement for the OPCW, which it upholds in regular audits to this day.

My answer to why has the OPCW been so successful therefore is – because the OPCW knows how to do its job. The Organisation works according to validated processes, applies proven methods and procedures that are based on solid science.

„Determined for the sake of all mankind, to exclude completely the possibility of the use of chemical weapons …“ The Preamble came under attack on 21 August 2013. The use of Sarin in Ghouta shocked the world and the OPCW. Looking back, the year 2013 marked a new beginning for the Organisation.

We all remember the brave actions of the UN, the WHO and the OPCW Director-General with his Staff: supporting the UN Secretary General Mission of Prof. Sellström to Ghouta, and – once the Syrian Arab Republic had acceded to the Convention – immediately thereafter commencing verification activities to secure the stockpiles in a country at war. In the midst of this unprecedented challenge, the OPCW was awarded the Nobel Peace Prize for making the world a safer place – having verified the destruction of tens of thousands of tons of chemical weapons through the watchful eyes of its inspectors.

What challenges lie ahead?

Today's challenges date back to 2013. For its first 16 years, the Organisation implemented the Convention largely hidden from the public eye – and suddenly – it found itself centre stage. The successful UN-OPCW Joint Mission to remove Syria's chemical stockpile in 2014 was followed by new allegations of chemical weapons use in Syria. Ambassador Üzümcü created the Fact Finding Mission to investigate these allegations of use and he established the Declaration Assessment Team to clarify questions in Syria's Declaration. OPCW Inspectors were now operating regularly in a war zone. They were shot at and briefly kidnapped – their biggest risk was no longer an exposure to highly toxic chemicals but to be physically harmed in an armed conflict – much had changed for the work of the Secretariat's staff compared to the routine inspections they were used to. OPCW Inspectors volunteered for these high-risk missions and the Director-General had to weigh up the dangers he was willing to expose his staff too. Allow me to express my sincere gratitude: The OPCW was truly "Determined for the sake of all mankind"!

Then in 2015, responding to the repeated findings by the OPCW Fact Finding Mission of Chemical Weapons use in Syria, the UN Security Council created the OPCW-UN Joint investigative Mechanism, the JIM, to find out who was responsible. The JIM investi-

Why is the OPCW so successful? Because it knows how to do its work.

gated for two years, under two different leadership panels and with two different teams. Both their findings were very similar – ISIL had used Sulfur Mustard, the Syrian Arab Republic had used Chlorine and the nerve agent Sarin. The newly established OPCW Investigation and Identification Team came to the same conclusions in 2020.

The UN Security Council and the OPCW Policy Making Organs were provided with concrete findings that a State Party was using Chemical Weapons. Syria denied them as did some of its supporters. Alternative narratives were fabricated and investigators publicly discredited, with the aim to diminish the evidence. However, none of this makes the factual findings any less true, and here I see the first challenge for the OPCW – which is communication. How can the findings of an investigation be better communicated to the public? Findings that were established according to methods that have been proven to work. How can we successfully counteract streams of disinformation, in order for the OPCW message to stand out? The OPCW may have to do better, but it cannot do it alone – help from partner organisations, from Member States, from civil society and the classic media will be required.

The second important challenge that I see is, how to deal with impunity for chemical weapons use? The Technical Secretariat – the investigators, the Designated Laboratories and the scientists – all have completed their work. Impunity is a political challenge and the instruments of the Technical Secretariat that made the OPCW so successful are of no help.

What the Secretariat should do in the absence of a political solution is to continue defending and explaining the findings, and preserve the evidence as well as the knowledge of how it came about; the OPCW must be ready, when the time for justice has arrived.

The OPCW is building a new Centre for Chemistry and Technology, which is financed by voluntary contributions from many countries, including large donations from Germany. This new Chemtech Centre will allow new interactions with Member States to advance the understanding of the underlying science of chemical weapons investigations. It will also become the new OPCW training centre and as such, support capacity building in Member States; and, it will help further developing the technical capabilities of the OPCW, to meet new and emerging threats from chemical weapons.

How unity in the international community can be strengthened in dealing with treaty violations?

My allocated time is almost up and I limit myself to one suggestion: discussions of how to penalise violations should be more clearly separated from the question of accepting the findings presented by the investigators. – Why? The OPCW applies best practices, it

maintains an internationally accredited quality system, it employs impartial staff from around the world, and it subcontracts sample analysis to the most qualified chemical weapons laboratories to date. If a State Party has doubts about an investigation, it should specify what additional information it requires to be convinced. It is one thing for a Member State to abstain, when penalising is decided, and another, when the question is about accepting the findings. In order for the OCPW to move forward, accepting an investigation report should be the result of a critical review of the evidence and hence, independent from political affiliation.

Ladies and Gentlemen
The Verification Regime of The Convention is there for the benefit of all Member States. We only have one OPCW – it took us a long time to build it, and we hope it is there for us – Determined for the sake of all mankind, to exclude completely the possibility of the use of chemical weapons – for the next 25 years!

HAPPY BIRTHDAY, and Thank You, OPCW!

The CBW network for a comprehensive reinforcement of norms against chemical and biological weapons (CBWNet)

The research project CBWNet will be carried out jointly by the Berlin office of the Institute for Peace Research and Security Policy at the University of Hamburg (IFSH), the Chair for Public Law and International Law at the University of Giessen, the Peace Research Institute Frankfurt (PRIF) and the Carl Friedrich Weizsäcker-Centre for Science and Peace Research (ZNF) at the University of Hamburg.

The joint project aims to identify options to comprehensively strengthen the norms against chemical and biological weapons (CBW). These norms have increasingly been challenged in recent years, inter alia by the repeated use of chemical weapons in Syria. The project scrutinizes the forms and consequences of norm contestations within the CBW prohibition regimes from an interdisciplinary perspective. This includes a comprehensive analysis of the normative order of the regimes as well as an investigation of the possible consequences which technological developments, international security dynamics or terrorist threats might yield for the CBW prohibition regimes. Wherever research results point to challenges for or a weakening of CBW norms, the project partners will develop options and proposals to uphold or strengthen these norms and to enhance their resilience.

The joint research project is being funded by the Federal Ministry of Education and Research for four years (April 2022 until March 2026).

04 Challenges in the anniversary year of the Biological Weapons Convention

Fifty years after its opening for signature, Russia made allegations against Ukraine and the USA under the Biological Weapons Convention. These allegations and the tense geopolitical environment caused by the war in Ukraine cast a shadow over the Ninth BWC Review Conference, which nevertheless produced an unexpectedly positive outcome.

Maximilian Brackmann

Since the Biological Weapons Convention (BWC) was opened for signature in 1972, 185 countries have ratified the treaty. The Convention provides means to clarify ambiguities, doubts and speculations regarding the implementation of and compliance with the Convention (Art. V), and it can, if necessary, refer a matter to the UN Security Council to initiate an investigation into an alleged breach of the Convention (Art. VI).

Article V also stipulates that States Parties should be able to consult and cooperate with each other to resolve problems that may arise in the application of the treaty. This happened for the first time in the history of the Convention in August 1997, when Cuba accused the USA of spreading insects (*Thrips palmi*) from aircraft to destroy entire crops. However, the consultative meeting did not reach a conclusion on this matter, as Cuba presented insufficient evidence to convince the States Parties.

Russian Accusations

For years, Russia has been expressing speculations, directly or indirectly, about an offensive US bioweapons programme carried out on territories close to the Russian border. In 2018, for example, Russia accused the USA of using the Lugar Center for Public Health in Tbilisi, Georgia, as a cooperation partner of the US Department of Defence for a bioweapons programme. Russia also made numerous

The Security Council votes on a resolution put forth by the Russian Federation to set up a commission consisting of all members of the Council to investigate its complaint about the non-compliance by the United States and Ukraine with their obligations under the Biological Weapons Convention. The draft resolution received support from China, while France, the United States and the United Kingdom vetoed it, and the 10 remaining Council members abstained from voting. The resolution was not adopted.

allegations against the US and Ukraine shortly after it started its attack on Ukraine. On 6 March 2022, for example, the Russian Ministry of Defence announced that it had found evidence of a biological weapons programme during the Ukraine war. These allegations were discussed, among others, in the UN Security Council, whereupon the High Representative for Disarmament Affairs, Izumi Nakamitsu, reiterated that the Office for Disarmament Affairs (UNODA) had no information about a biological weapons programme in Ukraine.

In September 2022, consultations under Article V of the BWC took place at Russia's request. During these consultations, Russia accused Ukraine and the US of non-compliance with Article I of the BWC. This article prohibits states from developing, producing or stockpiling biological weapons. In support, Russia submitted numerous documents. The documents show the extent to which the US Department of Defense, as part of its Biological Threat Reduction Program, is supporting Ukraine in building a public health infrastructure in the area of infectious diseases. According to Switzerland's assessment, however, the documents do not allow any conclusions to be drawn about an offensive biological weapons programme. Hence, Switzerland rejected Russia's accusations in clear terms: *"Switzerland is of the firm view that the allegations made have not been substantiated; that the conclusions drawn are neither convincing nor credible; and allow in no way to draw the conclusion that the obligations of the United States and Ukraine under the BWC have been violated"* stated Ambassador Félix Baumann, Switzerland's permanent representative to the Conference on Disarmament in Geneva.

While these consultations were still ongoing, Russia announced that it would invoke Article VI and formally take the allegations to the UN Security Council. In fact, on 24 October 2022, Russia introduced a draft resolution in the UN Security Council, which was re-

A special working group is to discuss measures that could significantly strengthen the BWC.

jected with two votes in favour (Russia, China), three against (France, UK, US) and ten abstentions (Albania, Brazil, Gabon, Ghana, India, Ireland, Kenya, Mexico, Norway, United Arab Emirates). Some of the states that abstained also stated in their explanations of vote that they did not believe in the Russian allegations and that an appeal to the Security Council should be based on solid facts. They had abstained, however, to ensure that it would be possible in future to refer questions on the Biological Weapons Convention to the Security Council under the provisions of Article VI.

Surprising progress at the Conference

In this tense environment, the Ninth Review Conference of the BWC took place from late November to mid-December 2022. Numerous proposals were put forward to strengthen the Convention, such as a system for assessing scientific advances, a committee to strengthen international cooperation for the benefit of developing countries, or the establishment of working groups on institutional strengthening of the Biological Weapons Convention

After tough negotiations, a final document was adopted on 16 December 2022: The States Parties decided that a special working group should discuss measures that could significantly strengthen the BTWC in the following areas:

- international cooperation and assistance
- scientific developments
- confidence-building measures and transparency
- compliance and verification of the treaty
- national implementation
- assistance, response and preparedness in the event of a threat resulting from a violation
- organisation, institution and finance

Although the Ninth Review Conference was not initially under a good omen, its decisions recorded in the final document are substantial and possibly trendsetting. The coming years will show how the working group will organise itself, which of the proposed measures will be adopted, and whether they will command consensus at a Special Conference or at the Tenth Review Conference in 2027.

05

Project “Comprehensive overview of the current state of NBC Protection in Switzerland”

The task of NBC protection is complex and multifaceted. Different disciplines and numerous actors from the Confederation, cantons, communes and third parties are involved. Critical analysis and further development of the overall system is therefore an ongoing task. Under the leadership of Spiez Laboratory, the main partners in Swiss NBC protection have in recent years undertaken a comprehensive analysis of the situation and developed numerous concrete proposals for improvement, with the project “Comprehensive overview of the current state of NBC Protection in Switzerland”.

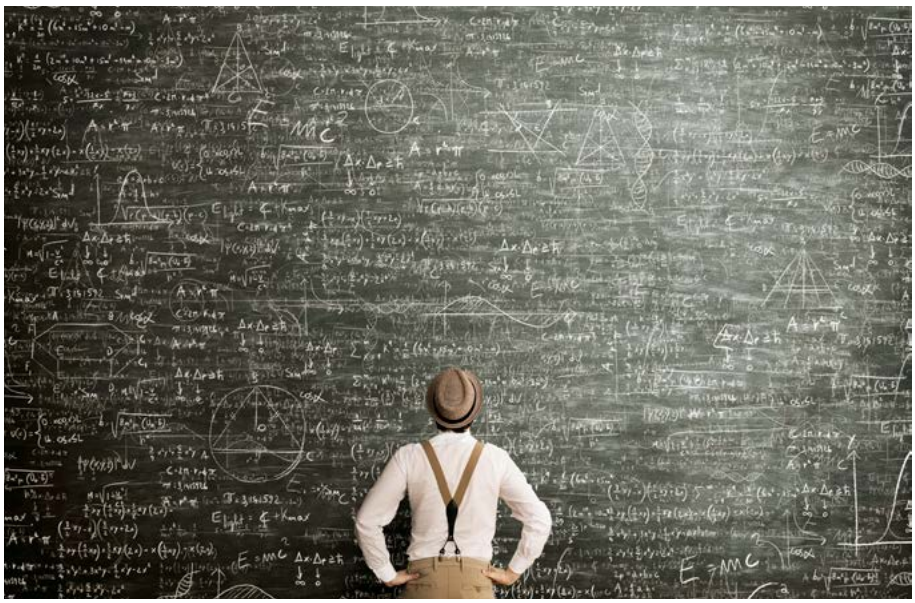
César Metzger

NBC protection includes protection against atomic (nuclear and radiological), biological and chemical hazards. Unfortunately, the risk posed by NBC substances has increased significantly worldwide in recent times. This is illustrated by several major events and developments such as the accident at the nuclear power plant in Fukushima in 2011, the Ebola epidemic in West Africa from 2013 to 2016, the repeated use of chemical weapons in Syria from 2013 to 2018 and the SARS-CoV-2 pandemic since 2019. In the context of the war in Ukraine, the NBC threat has become particularly acute in the information sphere in the form of NBC-related accusations, but above all due to Russia's repeated threats to use nuclear weapons.

In recent years, NBC substances have also been used on several occasions for targeted attacks on exposed individuals: One should recall, for example, the use of toxic chemicals against the then Ukrainian presidential candidate Viktor Yushchenko in 2004 and the fatal attack with the radioactive substance polonium against the former Russian secret service agent Alexander Litvinenko in London in 2006. More recently, hitherto undeclared chemical agents (so-called Novichoks) have been used twice in assassination attempts: in 2018 against the Russian-British double agent Sergei Skripal in Salisbury and in 2020 against the Russian opposition politician Alexei Nawalny in Russia. The deadly attack with the chemical agent VX against Kim Jong-nam in Kuala Lumpur in 2017, on the other hand, was a different matter.

Overarching trends in society, the economy, politics and technology also have an impact on NBC protection: the NBC risk landscape is becoming increasingly complex; on the other hand, technological and organisational advances are also constantly being implemented in NBC protection.

In this context, the Federal Office for Civil Protection (FOCP) was commissioned in 2018 by the Political Platform of the Swiss Security Network (PP SSN) to conduct an analysis of the current state of NBC protection in Switzerland and to develop proposals for improve-



The NBC risk landscape is becoming more and more complex.

ments. Spiez Laboratory took over the management of the project "Comprehensive overview of the current state of NBC Protection in Switzerland". In the first part, the hazards currently relevant to Switzerland were examined by means of reviewing, updating and expanding the NBC reference scenarios. In order to cover the wide range of tasks in the field of NBC protection, all the actors involved and the relevant legal frameworks were compiled as far as possible. The work then focussed on a systematic survey of over 300 actors in NBC protection from the Confederation, the cantons, communes and third parties. The emphasis was on identifying existing deficits in Swiss NBC protection.

In a second part, the reported deficits were successively consolidated in several workshops with representatives of the Confederation and the cantons. A total of 22 solutions were developed for the 16 most important deficits, using direct, iterative exchanges with the lead organisations. Some of these could be implemented directly, and the implementation of other solutions could already be initiated during the project work. Finally, for about one third of the solutions, a lead actor was identified who would be responsible for the short- to medium-term implementation.

On 9 December 2022, the Federal Council took note of the results of the project and approved the proposals formulated by the project management for the further implementation of the improvement measures. The assessment showed that Switzerland is basically well positioned in NBC protection. The legal basis is sufficient and up-to-date, and the structures, processes and instruments work. However, the large number of hazardous substances, scenarios and actors poses a challenge. It is therefore important to have good technical expertise, clear responsibilities and a continuous dialogue between the actors.

In some areas, the analysis has revealed significant information deficits among the actors involved. As a central improvement measure to rectify this situation, the creation of the federal NBC exchange platform (APABC) is planned. This body will form the so far missing counterpart at federal level to the already existing Cantonal NBC Coordination Platform (KPABC). This will improve overall coordination in Swiss NBC protection and close a gap in NBC protection that has existed up to now. The Federal Council has entrusted the FOCP with the implementation of this exchange platform.

The analysis also identified a need to supplement or further develop conceptual foundations. To this end, a performance profile for civil defence in the NBC sector is being drawn up under the leadership of the FOCP and with the participation of the cantons. Based on this, the targets for operational and protective material for civil defence will be drawn up. The implementation of these measures follows the directions for improving national NBC protection as set out by the Federal Commission for NBC Protection (ComABC) in its strategy "NBC Protection Switzerland" 2019.

The details of all 22 measures developed as part of the project can be found in the report on the "Comprehensive overview of the current state of NBC Protection in Switzerland", 2nd report: Proposed solutions to remedy the deficits published on the FOCP website. [1]

To overcome the lack of information, a federal NBC exchange platform is planned.

[1] Available in German and French:
Auslegeordnung ABC-Schutz Schweiz. Bericht 2: Lösungsvorschläge zur Defizitbehebung
Protection NBC en Suisse: état des lieux. Rapport 2: mesures proposées pour remédier aux déficits
https://www.babs.admin.ch/de/publikservice/downloads/abc-schutz.html

Example of the visualised hazard zones in the event of an accident involving a 220L tank wagon at Thun railway station with the TIC and former chemical warfare agent acrolein. red = lethal effect; orange = severe effect; yellow = noticeable indisposition, in each case for an exposure time of 60 minutes.

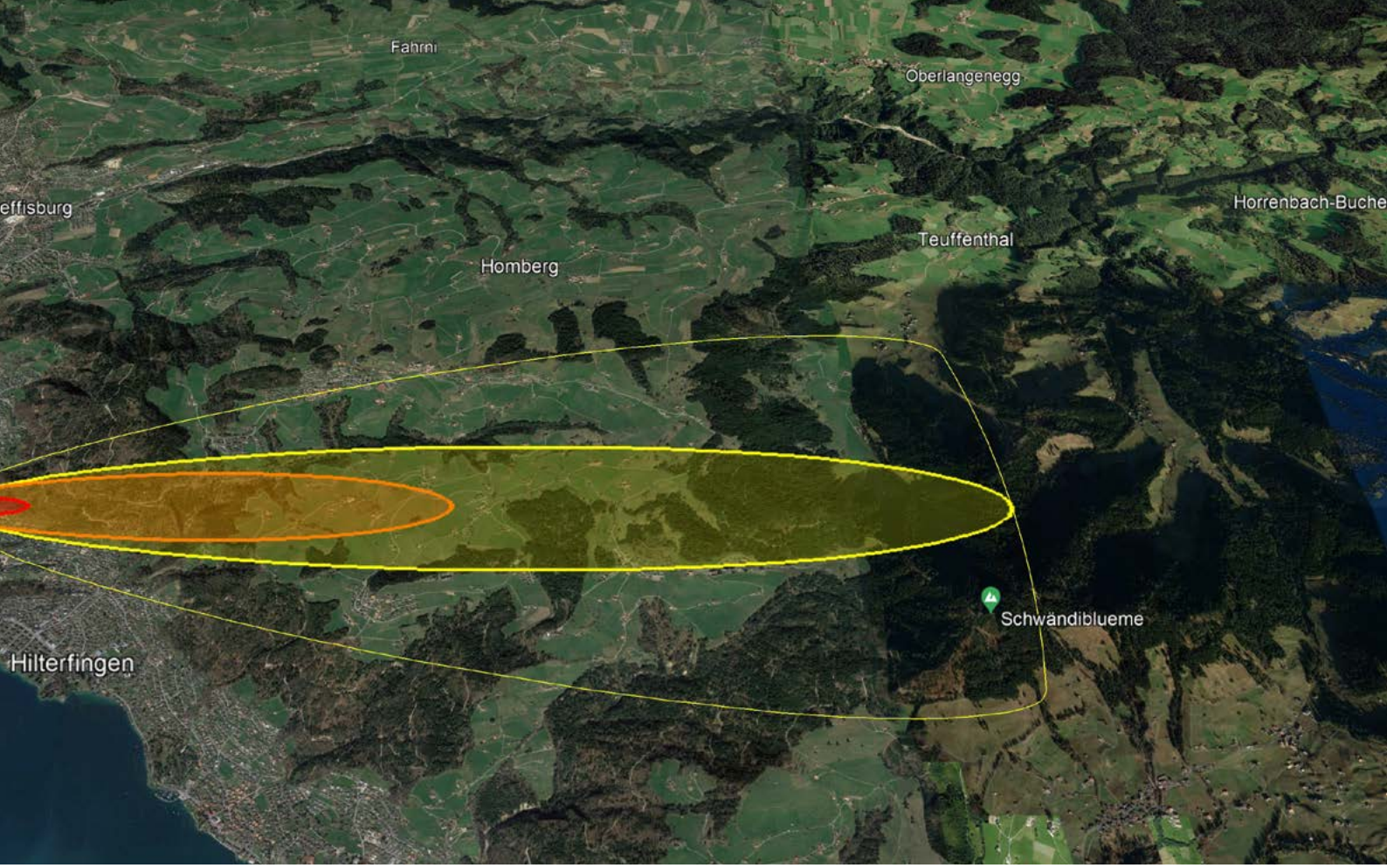
06

Participation in NATO Panels

Thanks to its involvement in NATO's Joint CBRN Defence Capability Development Group, Spiez Laboratory can exchange its expertise internationally and actively contribute to the development of future standards for detection equipment, decontamination agents or NBC protection equipment. In addition, Spiez Laboratory can participate in round robin measurements with other countries and thereby verify its test results.

Christian Gloor, Beat Aebi

Since the armed forces of the individual NATO member states are equipped differently, there are several working groups (so-called panels) within NATO that deal with current and future threats, equipment and tactics in order to promote interoperability between various member states. Although Switzerland is not a NATO member, its membership in the Partnership for Peace (PfP) enables access to these panels as well as to NATO standards, some of which are classified.



The Spiez NBC Centre, which consists of the NBC-EOD Centre of Competence of the Armed Forces and Spiez Laboratory, represents Switzerland within the PfP framework in the Joint CBRN Defence Capability Development Group. This group consists of seven panels that develop standards with regard to the requirements for protective equipment and detection devices or the design of exercises in the NBC area. Spiez Laboratory is represented in the following panels:

- Physical Protection Panel (PPP), responsible for physical NBC protection
- Detection, Identification and Monitoring Panel (DIMP), dealing with detection equipment
- Hazard Management Panel (HMP), dealing with decontamination
- Challenge Level Panel (CLP). Here, dispersion models are used to answer the following question: "For a given CBRN event, what is the expected hazard at a defined distance?"

Dispersion Modelling for Toxic Industrial Chemicals

One example of cooperation within the framework of the PfP is the dispersion modelling of toxic industrial chemicals (TIC). Such calculations can be used to estimate hazard distances in the event of a possible release of hazardous substances. In response to enquiries from other panels, the CLP carried out dispersion calculations of TICs. Spiez Laboratory calculated the dispersion of 15 TICs according to defined scenarios with different meteorological conditions such as ambient temperature or wind speed. For the dispersion modelling of the 15 TICs, two well-known software packages from two countries were used, as a comparison of initial results between the participants had shown diverging results. It turned out that due to different input parameters and computation models of the two programmes, the calculated hazard distances of individual TICs dif-

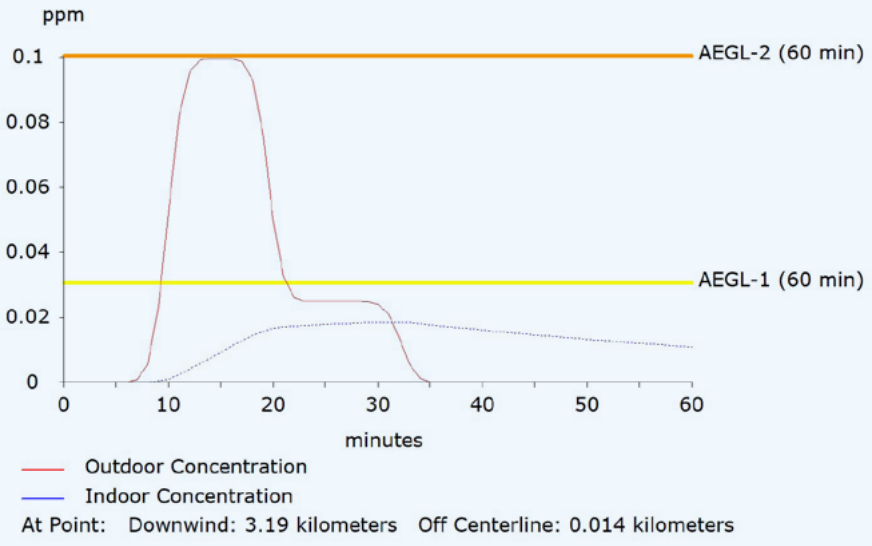
Although Switzerland is not a NATO member, thanks to the Partnership for Peace (PfP), Switzerland has access to NATO standards.

fered by a factor of up to 10. In addition to the different mathematical models used by the programmes, it can be assumed that they also make different assumptions about safety margins when calculating hazard distances. This can influence the organisation of the emergency forces at the incident site.

Despite the different results, the programmes employed are useful aids in the event of an incident, because they give those in charge an estimate of the hazardous zone. However, the calculated zone must be checked by measurements on site and, if necessary, adapted to the real situation.

Since the results of the calculations may have an influence on the requirements for NBC equipment, it is important not to rely on just one product. Because the programmes are model calculations, expertise in the C, B or R/N areas is necessary as well as knowledge of the software and its correct parameterisation in order to be able to assess the results. The comparison of the two programmes showed that a deeper understanding of a programme is essential to be able to interpret the calculation results correctly. The model calculations can be further enhanced with additional comparisons between the calculations and on the basis of real data or experimental releases.

Example of a calculated concentration curve within the calculated hazard zones



07

New detection method for chemical warfare agents: Optical detection of Novichoks and carbamates

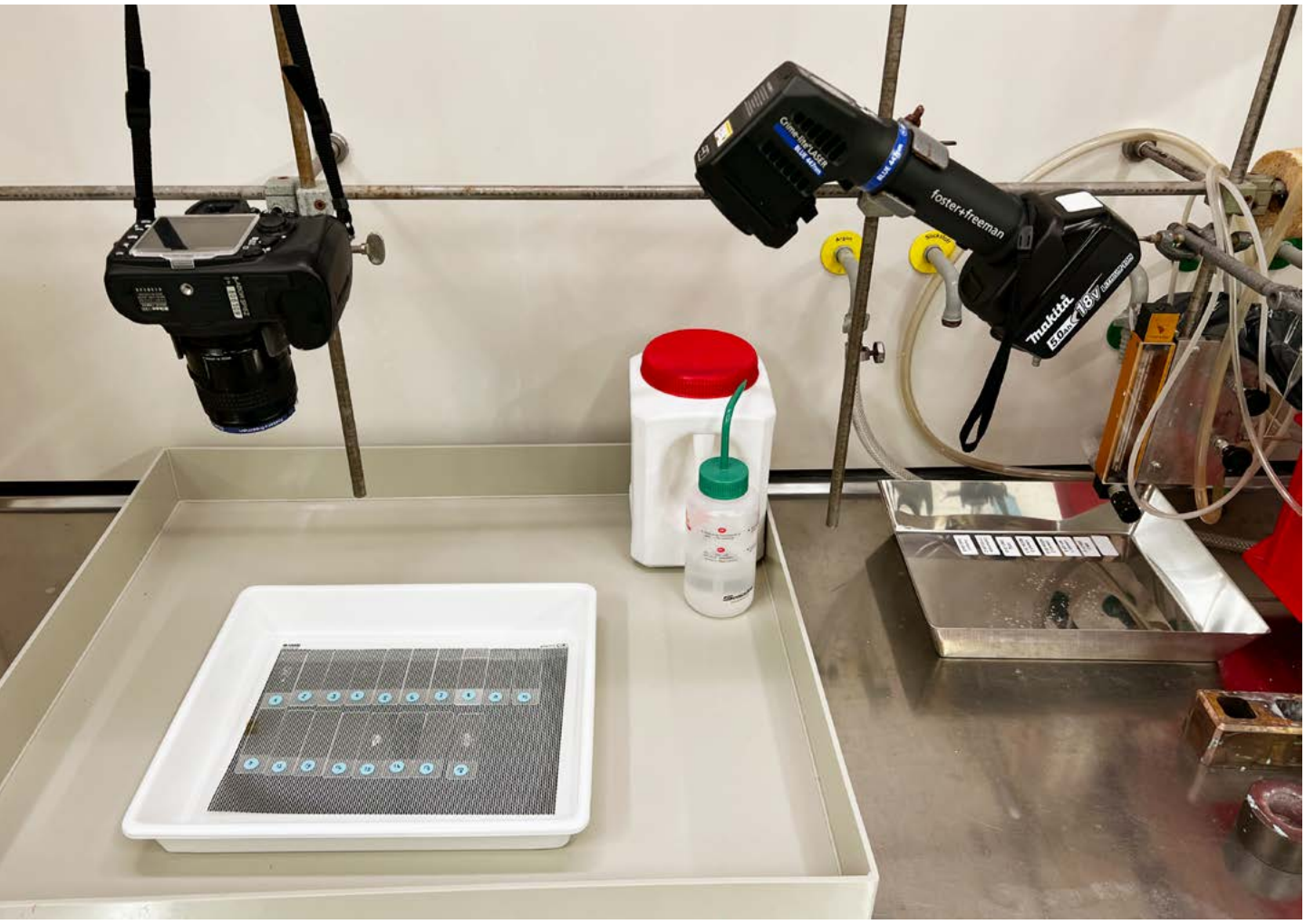
Novichoks and carbamates have recently been explicitly included in Schedule 1 of the substances controlled under the Chemical Weapons Convention (CWC). However, the substances are almost impossible to detect with standard detection equipment. In a collaborative project with the NBC Defence Centre of the Austrian Armed Forces, Spiez Laboratory has developed a rapid and reliable detection method for the detection of Novichoks and carbamates.

Benjamin Menzi, Christophe Curty
Gerald Bauer, Agnes Wildauer, Günter Povoden
(NBC Defence Centre of the Austrian Armed Forces)

By decision of the Conference of the States Parties of the CWC, new classes of substances were added to Schedule 1 of the substances controlled by the CWC in November 2019: Novichok and carbamate compounds. These are highly toxic compounds that act as cholinesterase inhibitors (like sarin, for example) and thus belong to the nerve agents.

Most of the classic chemical warfare agents such as sarin and yperite are sufficiently volatile to be detected easily in gaseous form with portable detection devices. This is of key importance for emergency service personnel as well as for specialists: in case of a suspected incident, the sources for sampling and decontamination can thus be located easily. However, this does not work for the Novichok and carbamate compounds: due to their physical properties, and in particular their low vapour pressure, they hardly occur in a gaseous state and are therefore barely detectable with portable detection devices. In the event of a use involving a Novichok agent (such as the 2018 attack on Sergei Skripal in Salisbury, England, or the 2020 attack on Alexei Nawalny in Russia), emergency responders will

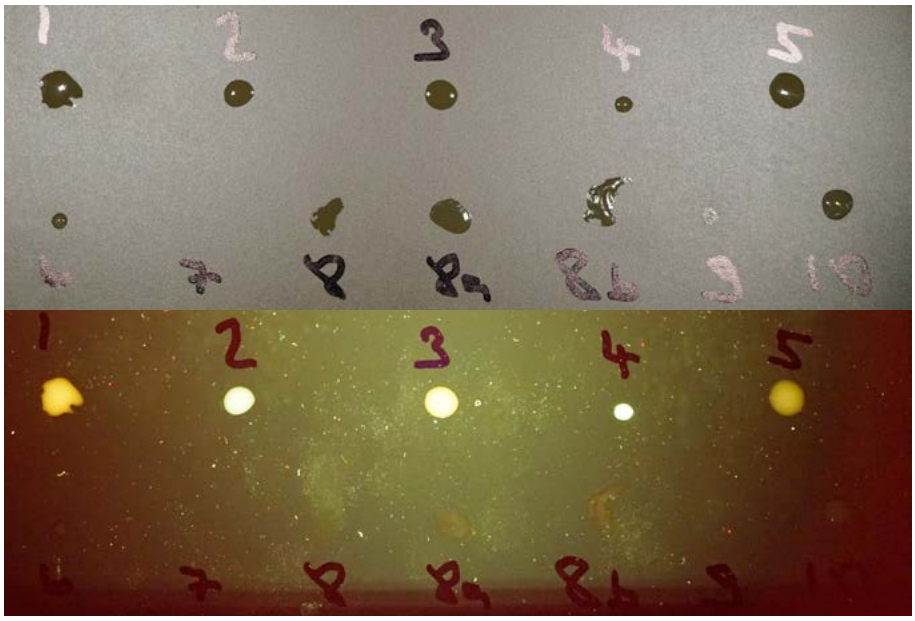
Experimental setting in the Chemical Safety Laboratory: A prepared sample is irradiated with a special forensic light source; the results are documented with a normal camera.



thus not be able to easily and quickly identify the source of the nerve agent with standard detection equipment. This means that the need for activities to be conducted in protective clothing increases massively.

Together with the NBC Defence Centre of the Austrian Armed Forces, the Chemistry Division of Spiez Laboratory implemented a project in 2022 that aimed at developing a rapid and reliable technique for the detection of Novichok and carbamate compounds. Specifically, a portable forensic light source was used to test the possibility of optically detecting substance sources.

In a first phase, samples were spiked with classical nerve agents such as sarin and VX, with blister agents such as yperite and lewisite, and in particular with Novichoks and carbamates; the samples were then analysed and the results compared: The samples were irradiated in the same way with light ranging from ultraviolet to infrared and their luminescence effect was assessed optically.



Anodised metal plates with applied droplets (10 µL) of Novichok and carbamate compounds (1–5) as well as reference substances (6–10), illuminated with white light (top) and blue light (445 nm) (bottom).

Pure substances in transparent glass vials, irradiated with white light (top) and blue light (445 nm) (bottom).

Two relevant observations were made:

1. The Novichok and carbamate compounds show a luminescence effect at light wavelengths between 420 and 560 nm (blue to green).
2. The classical neurotoxins do not show a luminescence effect at any wavelength in the visible light spectrum and the blister agents show only slight optical effects.

Based on these promising results, the optical detection experiments were focussed on the Novichok and carbamate compounds. The range of representatives of these two substance classes to be investigated was expanded. Only light with a wavelength of 420 nm (blue) to 560 nm (green) was used for the measurements. The substances were irradiated with three different lamps specially designed for forensic detection.

In the first phase, the measurements were carried out using light and dark paper as a background. In subsequent measurements, pure chemicals in glass bottles and on various materials, especially metal and plastics, were chosen as backgrounds. These materials are particularly relevant because they are used for door and window handles or as light switches and are thus predestined to cause poisoning through contact in an attack scenario.

As a result, the following insights were gained in the project:

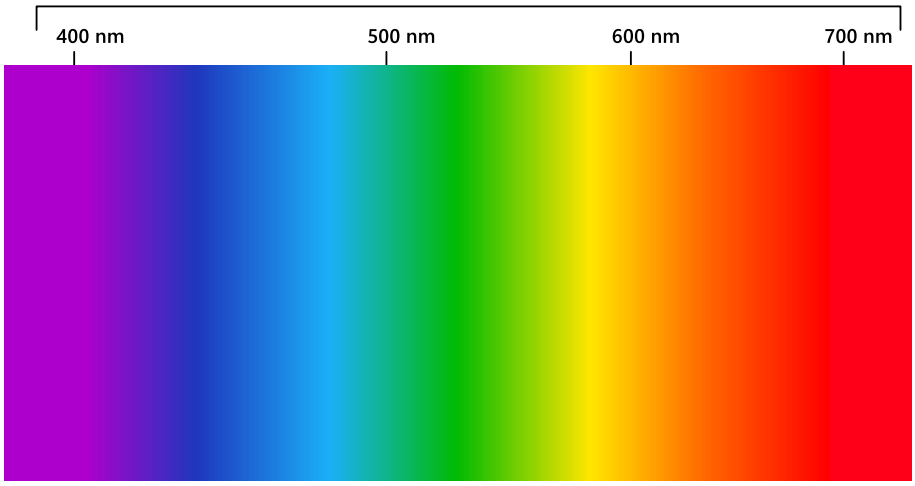
- All carbamates used show a significant luminescence effect, both in pure form and in aqueous solution.
- Different Novichok compounds tested showed a luminescence effect of varying strength.
- Texture and colour of the substrate influence the visibility of the applied substances.
- With regard to the lamps used, it was found that the lamp intensity as well as the range of adjustable wavelengths and the automatic preselection of the filters are important criteria for observation.

Summary and conclusions

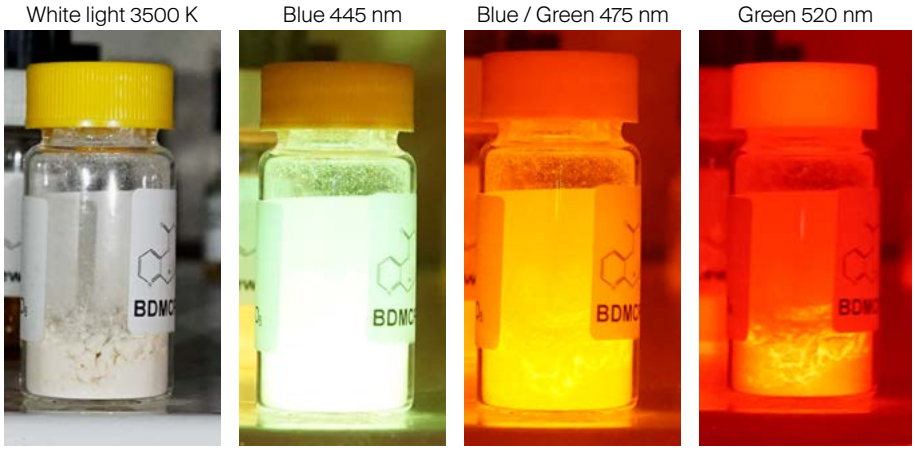
Novichok and carbamate compounds can be made optically visible using forensic detection lamps with a wavelength of 420 nm (blue) to 560 nm (green). However, the background influences the detection of a spot. In addition, practice and experience in the use of the detection lamp is necessary for the successful detection of traces, because there are of course other substances that show a luminescence effect in this wavelength range. Nevertheless, the use of a detection lamp can facilitate sampling for an analytical offsite investigation.

Spiez Laboratory has specialised DDPS emergency response teams (EEVBS) to deal with NBC incidents. In the event of an incident, they support the first responders (chemical fire brigade, police, fire brigade, ambulance etc.) with rapid advice and on-site intervention teams. The C-EEVBS is deployed in the event of an incident suspected to involve a chemical threat from toxic chemicals.

The project has been presented in a recent scientific publication:
Bauer, G.; Wildauer, A.; Povoden, G.; Menzi, B.; Curty, C. Crime Scene Novichok – Optical Detection of Fourth-Generation Agents (FGAs) Using Handheld Forensic Light Sources. Forensic Sci. 2023, 3, 231–244.



The visible light spectrum: 390–780 nm



Optical effects observed on a pure carbamate compound irradiated with light of different wavelengths.

Both partners involved in the project have already procured a detection lamp for possible use by specialists of their respective emergency organisations – i.e., in Switzerland the C-EEVBS team. In both countries, the follow-up activities for education and training with the new and novel detection tools are now being implemented.

For Spiez Laboratory, the exchange with the specialists of the Austrian Armed Forces was very valuable and enriching, also beyond the specific project work: as an expansion of knowledge on the topic of detection and generally on the deployment of specialists in the event of a possible terrorist attack with chemical warfare agents.

08

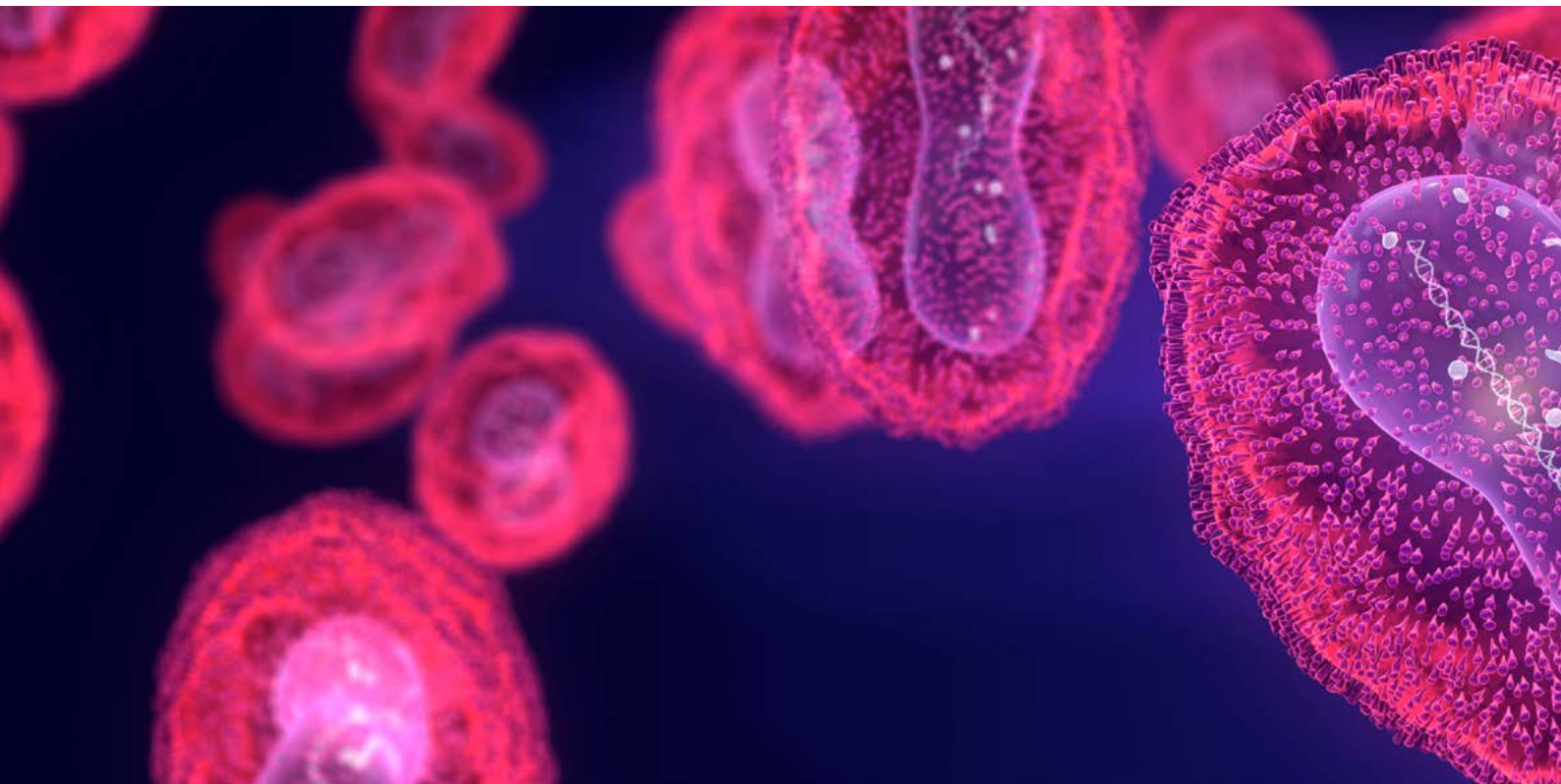
Analysis of Mpox Viruses

In spring and summer of 2022, the largest and most widespread Mpox outbreak to-date developed since the discovery of the pathogen previously known as "monkeypox" virus. The outbreak began in Europe and spread worldwide, with the highest case numbers in North America. Switzerland too, was affected: 13 days after the news that Mpox had emerged in Europe, Spiez Laboratory analysed Switzerland's first positive case.

Kristina M. Schmidt

Mpox viruses are close relatives of the variola virus, which causes smallpox in humans. Smallpox is considered eradicated. According to official information, isolates of the variola virus are only kept in two laboratories worldwide, in the USA and in Russia. The virus is a category A pathogen, which means it is considered a possible weapon of bioterrorism.

The variola virus and the Mpox virus belong to the Poxviridae family in the genus Orthopoxviruses. Both cause char-

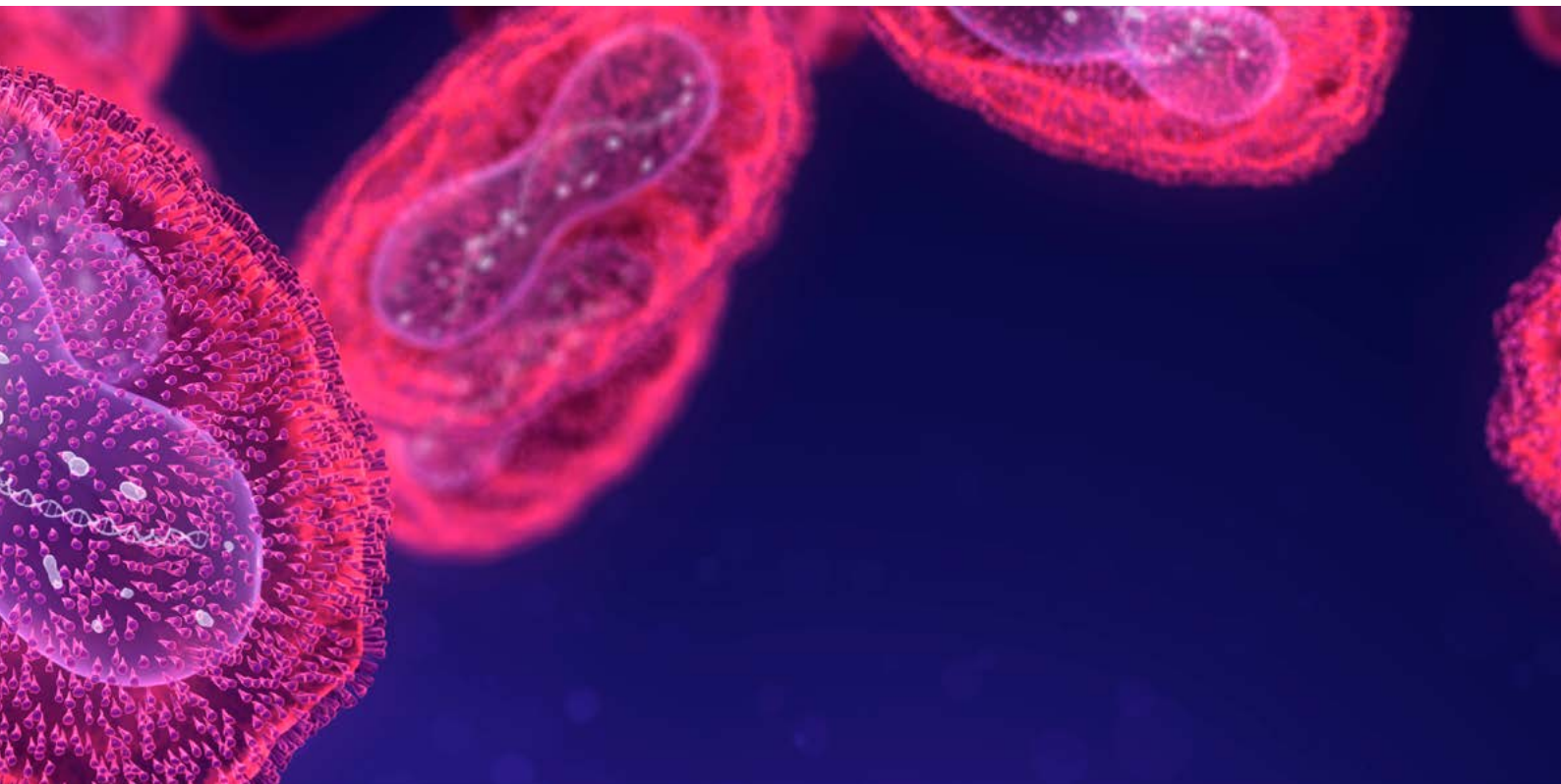


acteristic pustules in humans, however the progression of smallpox is much more severe than that of Mpox. The original name “monkeypox” dates back to the first identification of the virus in laboratory monkeys in Copenhagen in 1958. But this name is misleading: the viruses are mainly found in rodents, although the host reservoir of the viruses is not yet known. Against this background, the World Health Organization (WHO) has since changed the official name of the virus or more specifically the disease to “Mpox”.

The 2022 Mpox outbreak

Beginning in May 2022, an unusually large number of clinical cases of Mpox appeared, initially in the United Kingdom and then quickly also in other countries. It was foreseeable that the disease would also reach Switzerland in a short time: On 20 May 2022, the Biology Division of Spiez Laboratory received a request from the Institute for Infectious Diseases (ifik) of the University of Bern to analyse two clinical samples.

Spiez Laboratory had been preparing for such a case for some time: In order to be able to carry out work with viruses from the Poxviridae family, employees at the Biology Division have been vaccinated with the smallpox vaccine Imvanex since 2015 as part of a comprehensive medical preparedness programme. The vaccine has been approved by the European Medicines Agency (EMA), also for Mpox viruses since 2019 after various studies have shown that there is an 85% protection against this disease through cross-immunity. In addition, the required diagnostics were already established at Spiez Laboratory – as for a whole range of rare and dangerous pathogens. To this end, Spiez Laboratory implements a comprehensive biosafety concept and regularly participates in international round robin tests involving a wide range of highly pathogenic agents. Only because of this compre-



hensive preparation was it possible in the present case of a suspected Mpox to immediately carry out the analysis of the samples.

Laboratory analysis of Mpox viruses

The triage and inactivation of the samples was carried out under increased safety conditions in a BSL 2+ laboratory by vaccinated laboratory staff. BSL 2+ corresponds to a level 2 laboratory with additional personal protective equipment (PPE), including wearing a respirator unit where the breathing air is cleaned by a HEPA filter. After inactivation, the sample can be further processed under normal BSL 2 laboratory conditions. First, the viral nucleic acid (DNA) is extracted, and subsequently it can be detected by means of molecular analysis (PCR).

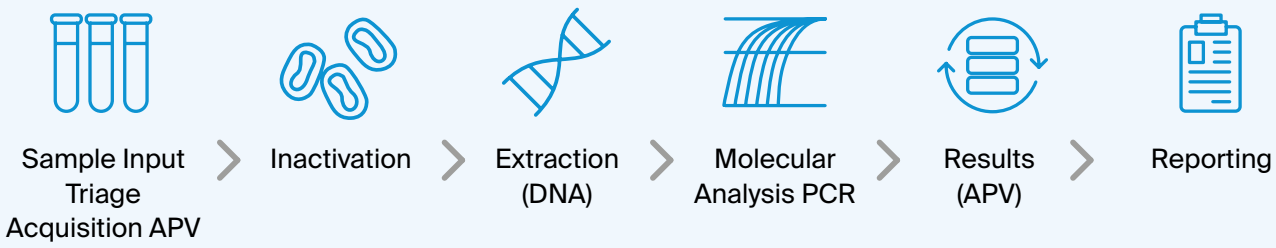
Mpox virus DNA was detected in one of the two patient samples using a specific PCR. Some 6 hours after receipt of the sample, the positive identification was already reported by Spiez Laboratory to ifik as the client, to the Federal Office of Public Health (FOPH) and to the cantonal doctor. As this was the first positive finding in Switzerland, the agencies involved had to expect a high level of attention: The result could have far-reaching consequences in terms of measures to ensure public health. Therefore, the sample was also forwarded to the National Reference Centre for Emerging Viral Diseases (NAVI) in Geneva for confirmatory diagnostics. NAVI then carried out the analyses of all other patient samples obtained in Switzerland. In Europe, the outbreak was contained relatively quickly: Since autumn 2022, only sporadic cases have been reported.

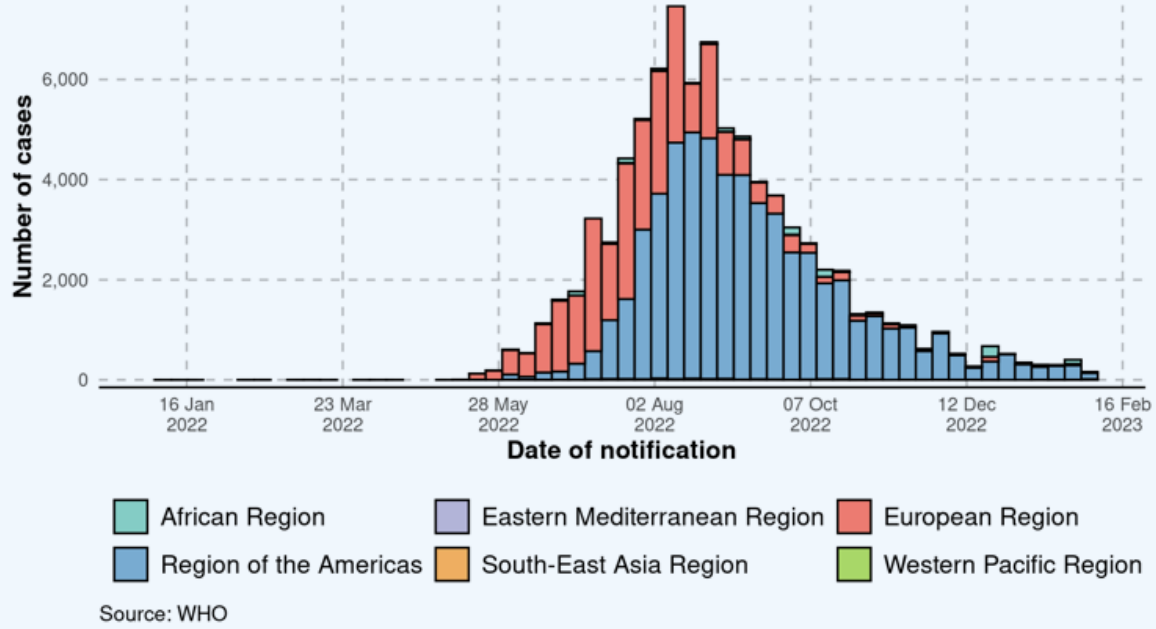
Human-to-human transmission

Unlike variola viruses, Mpox viruses are zoonotic, i.e., they are transmitted from animals to humans, which results in repeated outbreaks in endemic countries. Subsequently, the disease can also be transmitted from person to person through close physical contact, the exchange of body fluids or contact with infected material. For more than 50 years, there have also been isolated cases of Mpox outside the endemic countries, which could be linked to travel.

Process steps in the molecular analysis of pathogens

Mpox-Analysis





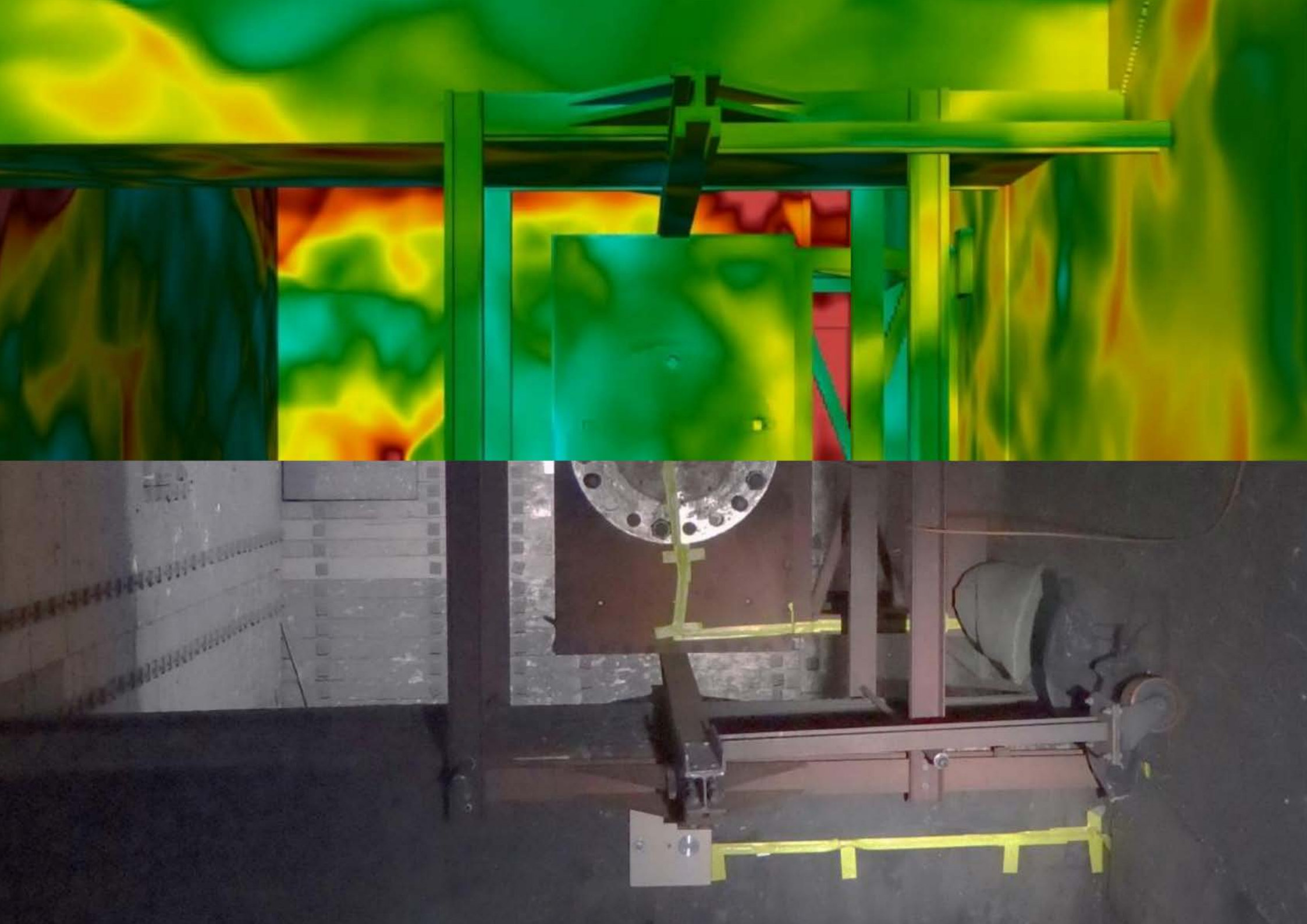
Global case numbers of the Mpox outbreak as documented by the WHO

However, human-to-human chains of transmission on a large scale were previously unknown: in the most recent outbreak, the virus spread to more than 110 countries. In total, more than 87,000 cases and 140 deaths have been confirmed (as of 11 May 2023, WHO). As early as 23 July 2022, the WHO declared the Mpox outbreak an "emergency of international concern". However, due to the possibility of vaccination and the availability of an approved therapy, the number of new cases of the disease has fallen sharply again worldwide.

The reasons for the unusually high human-to-human transmission compared to previous outbreaks are largely unknown. The following factors could have played a role:

- A change in the genome sequence of the virus;
- A change in human behaviour that increases transmissibility;
- Environmental factors that play a role in host-to-human transmission;
- An increase in the immunologically naïve population (i.e., the proportion of the population without immune protection) due to the end of smallpox vaccination in the 1970s.

Accordingly, there are different and above all multifactorial influences that can be decisive in predicting outbreaks. Many different aspects must be taken into account for rapid operational readiness and to ensure diagnostics in the case of unpredictable events. Spiez Laboratory constantly maintains a high level of preparedness to be able to react immediately in the event of an incident.



09

Conventional air blast testing: Interaction of numerical simulations and experimental analyses

Every five years the explosion safety valves approved by the Federal Office for Civil Protection (FOCP) are tested by Spiez Laboratory in the armasuisse S+T blast bunker. In the process, the durability and functionality of the explosion safety valves are determined in relation to air blast loads generated with explosives. In addition to the experimental measurements, numerical flow simulations were carried out as part of the 2022 test campaign. On the one hand, this validates the computer simulations, and on the other hand, it allows to analyse unexplained phenomena.

Lorenz Brenner

Starting point and objectives

Within the framework of its statutory mandate as well as industrial orders, the Collective Protection Branch of Spiez Laboratory tests explosion safety valves for protective structures with regard to their protection against the effects of conventional and nuclear weapons. In addition to the accredited laboratory tests with shock tubes, this requires additional analyses with explosives. In this process, an alternating, negative pressure load is generated due to shock wave reflections, which can lead to specific damage to the components. Since Spiez Laboratory does not have its own blast bunker, these analyses are carried out in cooperation with the technical specialists of armasuisse S+T in Thun. This also ensures the necessary technical know-how for the handling of explosives and in the development of a result-oriented measurement concept.

Depending on the defined protection class, the explosion safety valves must be challenged with a peak overpressure of 1 or 3 bar. In order to determine the correct test arrangement, various basic investigations have been carried out first. CFD simulations (Computational Fluid Dynamics) in addition provide more detailed information about the processes in the blast bunker. In contrast to the experimental measurements, which only record the pressure-time curve at specific points, the numerical analyses allow the pressure wave behaviour in the entire blast bunker to be visualised and analysed in detail. This ensures a sound and comprehensive data basis. In addition, the experimental data can be interpreted from a different perspective and the numerical results can be validated using the measurement data.

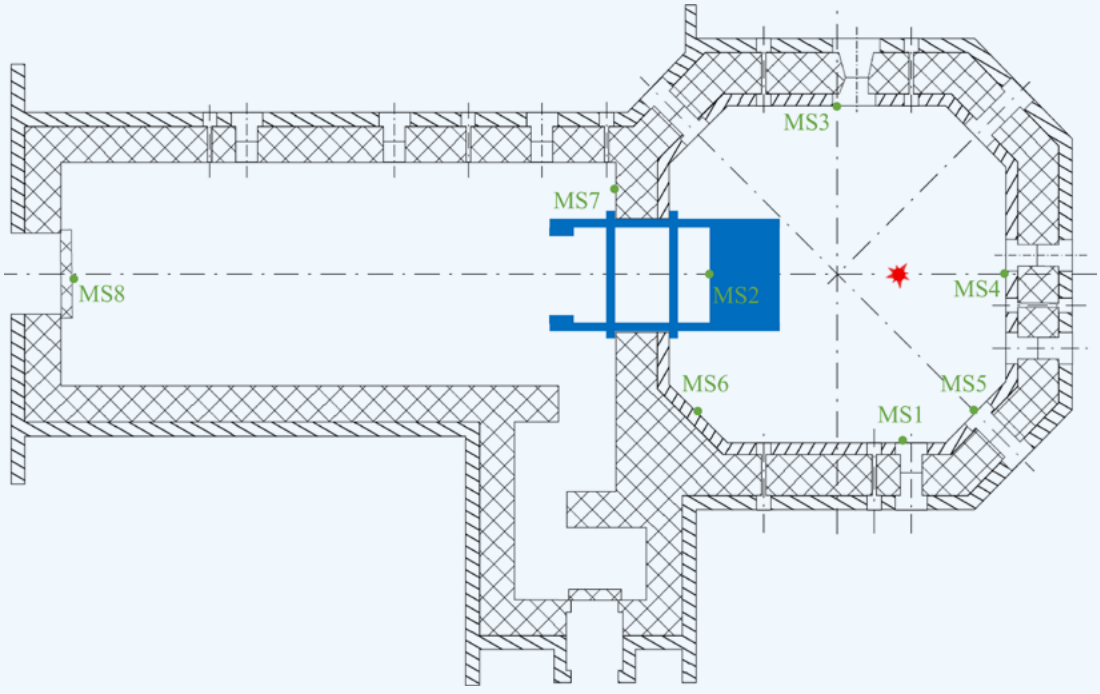


Figure 1: Schematic representation of the armasuisse S+T blast bunker in a horizontal cross-section with the test box and the support structure (blue, cf. fig. 2a/b), the pressure measuring points MS1 to MS8 (green) as well as the explosive sphere (explosion origin – red). MS1 corresponds to the control measuring point and MS2 represents the loading point where the test specimens are mounted.

Experimental investigations

Figure 1 shows a schematic of the blast bunker, which is approximately 15 m long, 3.8 to 6 m wide and 4 m high. To record the pressure-time profiles, 8 pressure sensors are mounted at different positions in the blast bunker (see Fig. 1, MS1 to MS8). They are screwed to wooden plates with an aluminium adapter and covered with thermal protection, as temperature gradients of several hundred degrees can occur during the explosion. In order to record the short-term dynamic effects, up to 1 million data points per second are recorded. A particular challenge lies in the laying of the sensor cables, as they are directly exposed to the blast wave. Any cable movements during the measurement can significantly disturb the signal. To prevent this and to shield the cables, they are covered with wooden rails, laid in steel tubes or fixed with adhesive tape (see Fig. 2c). Depending on the desired pressure load, the blast load is generated with spherical charges of 1 or 2 kg plastic explosive ("plastite"), which are ignited with a detonator (see Fig. 2d). During the one-week measurement campaign, a total of 110 blasts were carried out, which provides a good data volume for the evaluation and comparison with the simulations.

Numerical Simulations

For the CFD simulations, the APOLLO Blastsimulator software is used. This software has been specially developed for the simulation of explosions, shock waves and gas dynamics. Various explosives and corresponding models are implemented in the programme. This

Figure 2: (a) Test box with support frame and positioned explosive sphere. (b) Test box with support frame and mounting flange as seen from tunnel looking at MS2. (c) MS5, MS1 and MS6 from left to right. (d) Positioning of the detonator in the plastite sphere.

Figure 3: 3D model of the blast bunker (light grey transparent) with a section of the pressure distribution 20 ms after the detonation of a 2 kg plastite charge as well as the pressure measurement points visible from this angle. Negative pressure areas are coloured blue, positive pressure areas red.

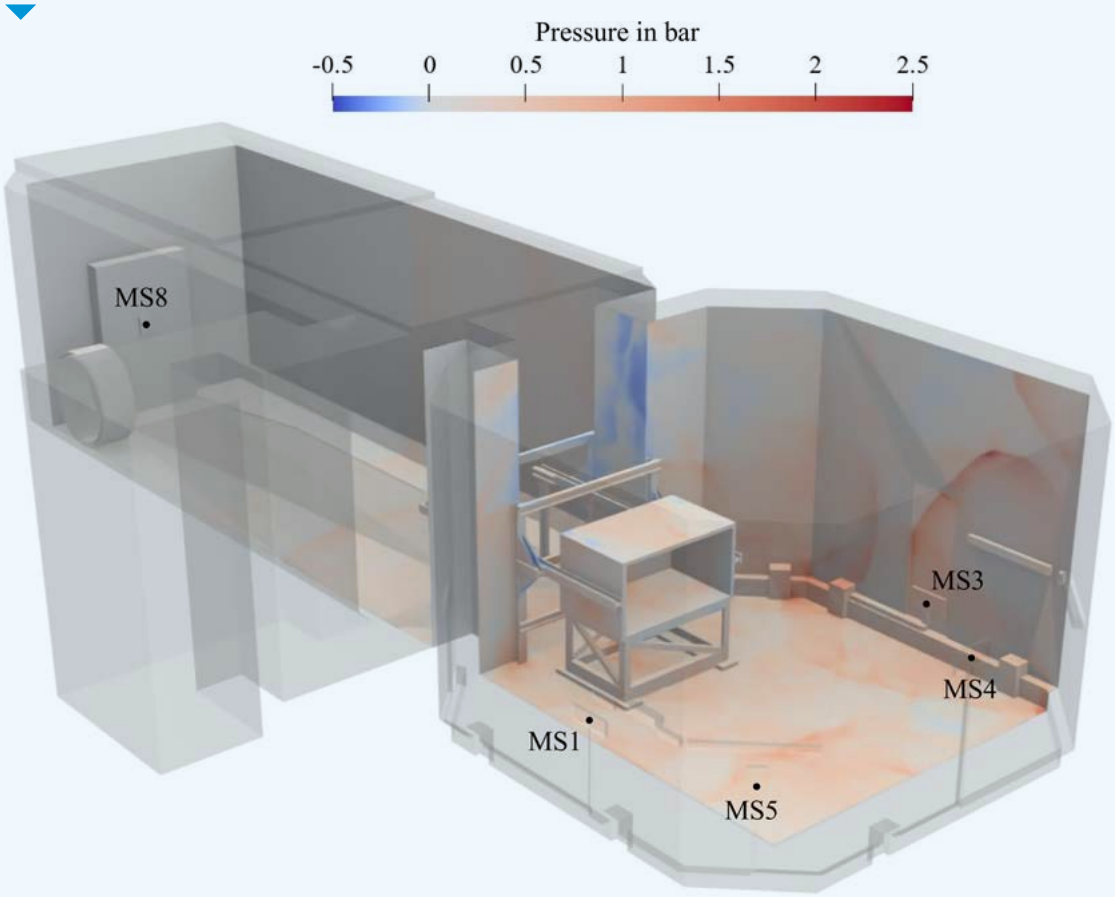
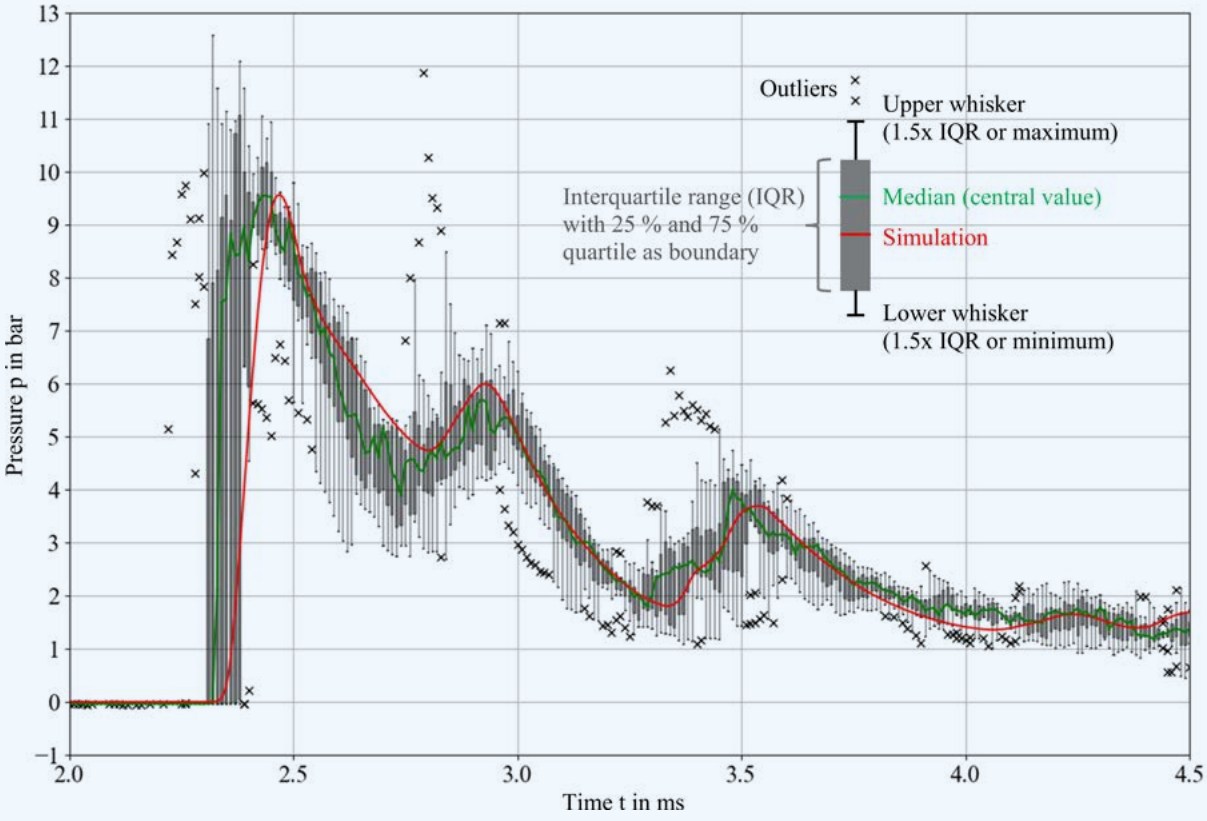


**Figure 4: Pressure-time curve at MS2 at load level 3 bar; 0 ms = time of explosion.
Simulation data (red) and measurement data, shown as a box plot with median (green), range from 25% to 75% quartile (dark grey, interquartile range), upper and lower whisker (1.5x interquartile range or minimum/maximum value) and outlier (x symbol).**



allows a highly accurate calculation of the blast wave propagation due to explosions. The simulation is based on a 3D model of the blast bunker (see Fig. 3), which was created on the basis of the technical documentation and manually recorded objects and conditions on site. Subsequently, the 3D model including the enclosed volume was converted into a calculation grid so that the equation solver could be applied. In this case, the calculation was carried out using approx. 280 million cube elements with an edge length of 1.25 cm. With the hardware used, such a simulation took about 64 hours. Despite sophisticated software and powerful hardware, CFD simulations still need to find a balance between conflicting objectives – achieving the most accurate results possible without pushing the hardware to its limits or generating excessively long calculation times.

Results and conclusions

Fig. 3 shows an example of the pressure distribution in the blast bunker 20 milliseconds (ms) after the detonation of a 2 kg plastite sphere. Various shock fronts (red) and negative pressure zones (blue) can be identified. Such contour plots of the pressure distribution allow a detailed insight into the flow behaviour in the blast bunker, which is not possible with the experiments alone. In addition, it is evident that an extremely complex flow pattern arises due to reflections, which would be essentially impossible to calculate by hand. Using the pressure-time curve at MS2 as an example (see Fig. 4), it also becomes apparent that the measurement data are subject to a certain degree of scattering, which amongst other factors is due to uncertainties in the placement of the detonator. This mainly influences the arrival time of the initial blast wave. Furthermore, outliers due to cable movements can be seen. The simulation data show an adequate agreement with the measurements, and even the pressure fluctuations are well approximated.

With the basic research conducted, it was possible to determine the extent to which pressure measurement and computer simulation have optimisation potential for application in air blast testing. In addition, the phenomena of shock wave propagation could be made visible and investigated in detail. Overall, the interaction of experimental and numerical analyses resulted in great scientific added value.

In CFD simulations, there is a certain conflict of goals – to achieve the most accurate results possible without pushing the hardware to its limits.

10 Monitoring of spare parts for the NBC Protective Mask 90

The NBC Protective Mask 90 is used for personal protection against chemical warfare agents. Since it is a high-quality system, the protective masks should be able to be used for as long as possible in the interests of sustainability and economy. For this purpose, protective masks are reconditioned as needed. With a test programme for spare parts for the NBC Protective Mask 90, Spiez Laboratory ensures the necessary quality control.

Thomas Friedrich

Since its first production in the 1990s, the NBC Protective Mask 90 (SM 90) has been used for military training and exercise purposes as well as for testing and research work. Members of the armed forces receive a SM 90 as part of their personal equipment and hand it in again after completing their military service. The masks are then reconditioned, stored and, if necessary, handed over again to other personnel. In addition to cleaning, the refurbishment also includes the replacement of individual components with newly produced parts. Since the SM 90 is safety-relevant protective equipment, these spare parts are subjected to random quality control by the Material Testing Branch at Spiez Laboratory before installation.

The replaceable protective filter separates aerosols that could contain toxic substances and adsorbs gaseous toxic chemicals. This prevents poisoning through breathing air. The outer mask made of rubber protects the face from poisoning by liquid and gaseous toxic substances. The SM 90 is also equipped with other components, e.g., an inlet and an exhalation valve, an inner mask for controlled breathing air flow (preventing the lenses from fogging up), a speech membrane protected against dirt and rain, a drinking device, optional corrective lenses with frames and an elastic strap for a gas-tight fit of the mask on the face.

Due to unavoidable material ageing, wear and tear, and also for hygienic reasons, individual components of the SM 90 are replaced by newly produced parts when the masks are reconditioned. This ensures the protective function of the masks even after more than 30 years since their original production.

Most of the components of the SM 90 are made of polymer materials, i.e., different kinds of thermo-plastics and different types of rubber. The performance characteristics of these materials only

1 Correction glass with frame
2 Elastic strapping
3 Outer mask
4 Speech membrane
5 Inlet valve
6 Exhalation valve
7 Connector for drinking bottle
8 Protective filter

Housing and membrane of the exhalation valve

Application of liquid chemical warfare agent

arise during the manufacture of the components, when the raw materials used take on their final state through processing conditions such as temperature, pressure, time and mechanical stress. To ensure that the components actually meet the performance requirements according to the technical terms of delivery, they are subjected to detailed tests by the Material Testing Branch. This is done randomly for each type of newly manufactured part and for each production batch.

For an unambiguous identification and characterisation of materials, measurements of various properties are necessary. An analysis strategy that provides an informative overall picture consists of the following steps: identification of the polymer, determination of the composition of the rubber compound, testing of optimal processing, determination of basic mechanical-physical properties and testing of resistance to ageing and to contact substances such as chemical warfare agents.

Thermoplastics are identified on the one hand by means of infrared spectroscopy (FTIR), which provides information about the characteristic chemical bonds of the underlying polymer type. On the other hand, dynamic differential scanning calorimetry (DSC) results in melting and decomposition temperatures that are characteristic for each polymer type. The composition of rubber compounds as well as the type of rubber can be analysed by thermogravimetry (TGA).

Optimal processing of thermoplastics is tested by measuring the viscosity of the plastic melt. This allows the detection of any damage to the polymer molecules caused by thermal and mechanical stress during processing. In the case of rubber, the quality of the vulcanisation (cross-linking density) is tested

by measuring the permanent deformation after prior compression.

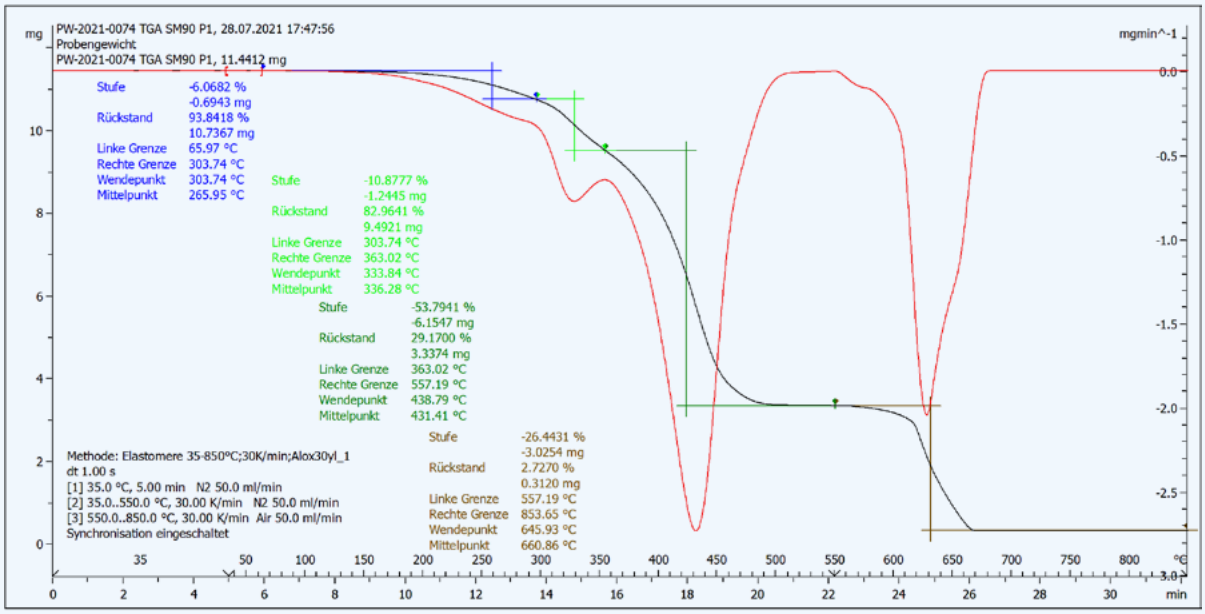
One of the most important requirements – one that must be verifyed by testing – is the required protection time of the external mask against liquid chemical warfare agents. This is determined by a chemical permeation test. The agent is applied to a sample of the outer mask and the time is measured until the agent has penetrated the sample. Detection of the permeated agent is done, for example, by measuring the electrical conductivity of water, which increases on contact with the warfare agent as a result of a chemical reaction.

Measurements of tensile strength, elongation at break and tear resistance in tensile tests show whether a material can withstand the mechanical stresses when in use. The resistance to thermal-oxidative ageing is examined by means of artificially accelerated ageing through warm air storage. The assessment is made on the basis of changes in tensile properties.

Some types of rubber are susceptible to cracking when exposed to ozone and must be protected against this by means of additives. Therefore, testing the resistance of rubber to ozone is mandatory.

All measured property values also serve as a reference for assessing the condition of the parts after many years of use or storage.

Analysis of the composition of rubber compounds using thermogravimetric analysis TGA



11 Spiez CONVERGENCE 2022: Summary of the Results

Spiez CONVERGENCE 2022 was already the fifth edition of this conference series that has recently been included as a "Science Diplomacy" measure under the new "Strategy for Arms Control and Disarmament 2022–2025" of the Federal Council.[1] As previously, the goal of the conference was to present relevant developments in science and technology and to discuss their impact on the prohibition of chemical and biological weapons. Altogether 66 participants from 12 countries and three international organisations accepted the invitation to attend the conference.

Stefan Mogl, Maximilian Brackmann

The Federal Office for Civil Protection (FOCP) was particularly delighted that Ambassador Fernando Arias, Director-General of the Organisation for the Prohibition of Chemical Weapons (OPCW) used the occasion of Spiez CONVERGENCE 2022 to pay a visit to Switzerland. He opened the conference and subsequently visited Spiez Laboratory, accompanied by Director Schärer (DDPS, FOCP), Ambassador Lüchinger (FDFA, International Security Division), and Brigadier Mäder (DDPS, International Relations Defence). In his address, the Director-General thanked Switzerland for its support for the Chemical Weapons Convention (CWC) and praised the multifaceted technical support rendered by Spiez Laboratory to the OPCW.

The conference focused on the following themes:

Manufacturing of peptides

With regard to new developments in the manufacturing of chemicals, the conference looked at production methods for peptides, and in particular those peptides that can be administered orally as therapeutics. Bicyclic peptides have emerged as particularly suited for this purpose. At this moment, some 200 peptide therapeutics are in an advanced state of clinical testing. From the perspective of arms control, peptides that can enter the blood stream and act systemically show a certain potential as chemical weapons agent.

Another development in the manufacturing of chemicals is the use of "confirmation cages". Coordination cages are three-dimensional chemical structures which self-assemble in solutions from

[1] See the press release of the Federal Council from 2 February 2022.

Ambassador Fernando Arias, Director-General of the OPCW, visits Spiez Laboratory at the occasion of the opening of Spiez CONVERGENCE 2022. Here together with Dr Marc Cadisch, Director Spiez Laboratory.

metal ions and organic ligands and which subsequently act like "reaction vessels". They selectively host "guest molecules" and facilitate chemical reactions that are otherwise difficult to implement.

Artificial Intelligence

Machine learning (ML) and artificial intelligence (AI) play an increasingly important role for the discovery of new chemical compounds today. In addition, algorithms are available for the planning of chemical synthesis. They compute a synthetic pathway and propose precursors and reactions. From an arms control perspective, these methods could be deployed for the development of new chemical weapons agents or for new production methods for known chemical weapons agents.

At Spiez CONVERGENCE 2021, a representative of an AI company demonstrated the capability of AI for the discovery of new toxic chemicals. Subsequently, this led to a publication under the title *"Dual use of artificial-intelligence-powered drug discovery"*[2], which attracted worldwide media attention. A second publication entitled *"A teachable moment for dual-use"*[3] picked up on this media response and discussed possible implications for the AI community and for science more widely. This underlined how important the discourse is between different experts, when it comes to recognising in good time the impact of new developments on the prohibition of chemical and biological weapons.

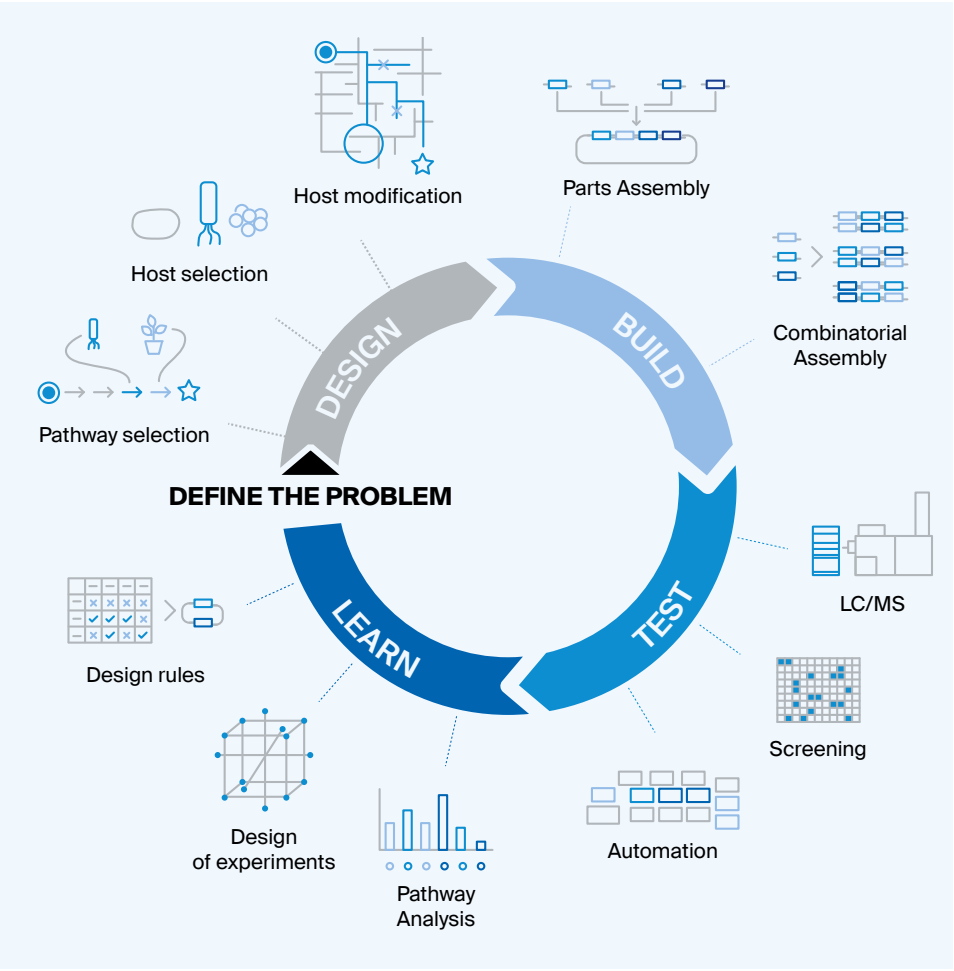
Spiez CONVERGENCE 2022 showed that the combination of AI, synthetic biology, automation, robotics, Big Data, and high-throughput synthesis and screening leads into a paradigm shift for how experiments are conducted. AI and ML technologies are perhaps approaching a point where they could become "game changers" that might profoundly affect the conventions on the prohibition of chemical and biological weapons.

Engineering of biological systems

Spiez CONVERGENCE regularly reviews new development in the engineering of biological systems. In this context, the conference looked at advances in the use of bacteriophages. Bacteriophages are viruses that affect bacteria whilst generally being harmless for humans. This is why they are being investigated as treatments for antibiotic resistant pathogens. Phages can also be designed, however, to cause harmful effects in humans. Another development focuses on artificial organelles: these are constructed from polymers with the aim of mimicking cellular functions and biological processes. A third theme related to the

[2] Urbina F, Lentzos F, Invernizzi C et al.: Dual use of artificial-intelligence-powered drug discovery. Nat Mach Intell 4, 189–191 (2022)

[3] Urbina F, Lentzos F, Invernizzi C et al.: A teachable moment for dual-use. Nat Mach Intell 4, 607 (2022)



engineering of biological systems was the employment of AI methods for proteins. AI is being used to elucidate the three-dimensional structure of a protein. Once this in known, predictions can be made about the biological function of this protein. AI methods are also being used for the design of de novo proteins - i.e., artificial proteins that display a desired and specific function.

In the same manner as it assesses advances in the engineering of biological systems, Spiez CONVERGENCE also evaluates new development in synthetic biology – the development of "biological parts". The deployment of AI and ML in synthetic biology today enables a refocussing from understanding biological processes to original design of such processes. Supported by process automation, these methods are being used to develop new biomedical applications and new biotechnological materials.

Biofoundries

A complementary development are cloud laboratories and biofoundries, which allow to further speed up the design cycle. From the perspective of Spiez CONVERGENCE, synthetic biology is evolving as a platform technology that will find applications in multiple areas of day-to-day life. This is why already today, states are investing significant amounts of money into the "bioeconomy" which they appear to consider of strategic importance. Synthetic biology also enables the development of new materials, by programming material properties into DNA. An example is the use of bacteria for the conversion of sugars into bacterial cellulose, which in addition can be functionalised with proteins. The construction of synthetic organisms, which is enabled by an increasingly wider global accessibility of cost-effective synthetic DNA, poses biosecurity questions from an arms control perspective: new materials are of interest as they may contribute to enhanced protections against chemical and biological agents.

Delivery of active substances

Another recurring theme of Spiez CONVERGENCE relates to the new development of systems for the delivery of therapeutics and active ingredients. In 2022, the conference dealt with microarray patches (MAPs) which can be used for self-application of vaccines and which could render needles and syringes obsolete. The requirements for maintaining a cold chain for MAPs also appear to be less stringent, which could result in a significant reduction of the costs and a simplification of the logistics of vaccination campaigns. Another field of research with relevance to

the delivery of therapeutics is electro genetics. This deals with the integration of the human body with the internet-of-things and develops respective interfaces. An example of a research project for a therapeutic application is an implant to treat diabetes. It uses genetically modified human Electro-β cells and allows insulin to be released by means of different stimuli.

Policy

The advances in biotechnology have turned it into a capability of strategic importance, capable of contributing to the solution of pressing problems. Governments are investing significant amounts of money into this field, striving for technological and economic control and political influence. Several developments also have the potential to enhance protection against chemical and biological weapons as well as strengthen methods to control them. At the same time, it is important to recognise that the perception of a limited military value of CB weapons may no longer be shared by all. When it comes to the possible misuse of scientific developments for new chemical or biological weapons, attention may have to focus again on states rather than terrorists or lone actors. This realisation is important with regard to the important strategic investments in the bioeconomy, the results of which inherently carry a certain abuse potential. In today's geopolitical climate, it is not self-evident that all states would resist the temptation to exploit this misuse potential. This remains a challenge for the future.

Some policy discussions in arms control bodies are stuck in the past. The same can be said about the CWC verification system and the instruments to ensure compliance with the BWC. Both systems were designed for state weapons programmes of the past. It is important therefore to also develop non-treaty instruments and mechanisms, for example by embedding the importance of dual use ethics with scientists, as they are the first line of defence against misuse.

As in previous conferences, Spiez CONVERGENCE 2022 has again demonstrated how important cross-community conversations between policy experts and practitioners from the worlds of science, technology and industry are. The next opportunity at Spiez will be during the sixth Spiez CONVERGENCE, in September 2024.

The conference report from Spiez CONVERGENCE 2022 can be downloaded at:
http://www.spiezconvergence.com

It is important to also develop non-treaty instruments and mechanisms, for example by embedding the importance of dual use ethics with scientists.

12

Ambassadors visit Spiez Laboratory

Spiez Laboratory is often the focus of public attention. This is also reflected in numerous requests for visits. At the invitation of the State Secretariat FDFA, around 80 ambassadors accredited in Switzerland visited Spiez Laboratory in June 2022.

Kurt Münger

The requests for visits and tours of Spiez Laboratory are many and varied; they come from partners in other authorities, political bodies, institutions from science and education, but also from companies, associations, service clubs and other organisations from Switzerland and abroad. By no means can all of them be answered positively. In general, only groups will be admitted that have a close political or professional connection to NBC protection and the activities of Spiez Laboratory.

Group photograph, visitors of the FDFA information event at Spiez Laboratory on 13 June 2022.

Each year, Spiez Laboratory receives around 50 groups of visitors. In 2022, these included, for example:

- Cantonal Councillor Paul Winiker, Head of the Department of Justice and Security, Canton Lucerne, President of the Intergovernmental Conference on Military, Civil Defence and Fire Services (RK MZF), with delegation
- Marie Claude Noth-Ecoeure, Head of the Department of Civil and Military Security, Canton Valais, with delegation
- The Cantonal Command Organisation, Canton Schaffhausen
- Corps Commander Hans-Peter Walser, Head of the Training Command of the Swiss Armed Forces, with his counterparts from Germany and Austria ("DACH meeting"), with delegations
- Ambassador Scott Miller, Ambassador of the US Embassy in Switzerland, with delegation
- Ambassador Fernando Arias, Director-General of the Organisation for the Prohibition of Chemical Weapons (OPCW), with delegations from the OPCW as well as the FDFA and DDPS
- The WHO Standing Committee of the Regional Committee (SCRC) for Europe
- The Directorate of the Swiss Federal Laboratories for Materials Science and Technology (Empa)
- Staff from Spiez Police Station, Cantonal Police Bern

In cooperation with the Protocol Section of the State Secretariat of the Federal Department of Foreign Affairs (FDFA), Spiez Laboratory was also invited to help organise an information event ("thematic excursion") in June 2022, for the ambassadors accredited to Switzerland. Around 80 participants attended the event, which was chaired by State Secretary Livia Leu.

In presentations by Marc Cadisch, Director Spiez Laboratory, Stefan Mogl, Deputy Director Spiez Laboratory and Head of Chemistry Division, and Isabel Hunger-Glaser, Head of Biology Division, the visitors received concise background information on NBC protection and NBC arms control. In addition, the guests were able to visit selected laboratory facilities and to engage in direct discussions with experts. The feedback for the event was extremely positive. In a tweet after the visit, State Secretary Leu described Spiez Laboratory as "our centre of excellence in the longstanding commitment of 🇨🇭 to global arms control". She was referring implicitly to the Federal Council's new "Arms Control and Disarmament Strategy 2022–2025". With this strategy, the Federal Council advocates the elimination of all weapons of mass destruction – in line with the vision of Spiez Laboratory: "A world without weapons of mass destruction".

ADN-Strategy

In February 2022, the Federal Council adopted the new "Strategy Arms Control and Disarmament 2022–2025" (ADN Strategy). With this strategy, Switzerland aims to contribute to international efforts to develop clear rules and innovative instruments for disarmament. The Federal Council explicitly adheres to the objective of eliminating all weapons of mass destruction. In this context, the strategy contains multiple references to the work of Spiez Laboratory and it demonstrates their importance for Swiss arms control. In the action area related to chemical and biological weapons, the central contributions of Spiez Laboratory are highlighted, in particular its close cooperation with the OPCW and the international events it has organised (Spiez CONVERGENCE and UNSGM Designated Laboratory Workshops).

https://www.spiezlab.admin.ch/en/kontrolle/unsgm.html
https://www.spiezlab.admin.ch/de/home/meta/refconvergence.html

13 Publications 2022

Nuclear Chemistry Division

Althaus Rolf

Nuklididentifikation und Ansprechverhalten von tragbaren Gammadetektoren

LN 2022-01 ALTF

Corcho José

Validierung der Messung von H-3 in Wasserproben mit Liquid Scintillation Counting (LSC)

LN 2022-01 CORJ

Corcho-Alvarado JA, Díaz-Asencio M, Röllin S, Herguera JC

Distribution and source of plutonium in sediments from the southern Gulf of Mexico

Environ Sci Pollut Res Int. 2022 Dec;29(57):85766-85776

Corcho Alvarado JA, Röllin S, Sahli H, McGinnity P

Isotopic signatures of plutonium and uranium at Bikar atoll, northern Marshall Islands

Journal of Environmental Radioactivity, Volume 242, 2022, 106795

Corcho-Alvarado JA, Gosteli R, Röllin S, Sahli H, Stauffer M, Burger M

Determination of strontium radioisotopes in routine and emergency samples

Applied Radiation and Isotopes, Volume 186, 2022, 110269

Corcho-Alvarado JA, Stauffer M, von Gunten C, Röllin S, Gosteli R, Sahli H, Astner M

Integrating the theory of sampling into a nuclear forensic investigation

Applied Radiation and Isotopes, Volume 190, 2022, 110513

Gosteli Regula

Radiochemische Trennverfahren von Sr-89 und Sr-90 in Lebensmitteln und Umweltproben mittels SR-SPEC® Extraktionschromatographie

LN 2022-01 GOSR

Kimák Ádám

Testing Nano-WATA™ for the Swiss Agency for Development and Cooperation SDC Humanitarian Aid and SHA

LS 2022-02

Kimák Ádám

Optimization of Ion Chromatography injection volume to improve standard anion analysis

LN 2022-01 ADK

Kimák Ádám

Methodenvalidierung zur Bestimmung der Standard Anionen mittels Ionenchromatographie Dionex ICS 6000 – Weiterentwicklung mit 50 µl Injektionsvolumen für den Konzentrationsbereich 0.4–30 mg/L

LN 2022-02 ADK

Ossola Jasmin

Validierung des Quecksilberanalysators MA-3000 NUC-Pm-066

LN 2022-01 OSJA

Ossola Jasmin

Validierung eines Mikrowellen-Königswasser-Aufschlusses nach DIN EN 16174

LN 2022-02 OSJA

Ossola Jasmin

Validierung des Rotors 41HVT56 für das Mikrowellenaufschlusssystem Multiwave PRO mvon Anton Paar

LN 2022-03 OSJA

Röllin Stefan

Nukleare Forensik: Collaborative Material Exercise 7 (CMX-7)

LN 2022-01 ROF

Röllin S, Corcho-Alvarado JA, Sahli H et al.

High-resolution records of cesium, plutonium, americium, and uranium isotopes in sediment cores from Swiss lakes

Environ Sci Pollut Res 29, 85777–85788 (2022)

Sahli Hans

Validierung der alphaspektrometrischen Bestimmung von Pu-238 und Am-241 in Wasser

LN 2022-01 SAHH

Sahli Hans

Validierung der alphaspektrometrischen Bestimmung von Pu-238 und Am-241 in Böden und Sedimenten

LN 2022-02 SAHH

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von Gunten Cédric

Training DPHE-FSL Laboratory in Cox's Bazar Bangladesh – Mission Review

LS 2022-03

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von Gunten Cédric

Assessment of hydrogen cyanide release from Osmofilm bags filled with guanidine thiocyanate solution

LS 2022-05

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von Gunten Cédric

Ringversuchsergebnisse 2021 der Prüfstelle STS 0028

LN 2022-01 VGCE

Biology Division

Jonsdottir HR, Siegrist D, Julien T, Padey B, Bouveret M, Terrier O, Pizzorno A, Huang S, Samby K, Wells TNC, Boda B, Rosa-Calatrava M, Engler OB, Constant S

Molnupiravir combined with different repurposed drugs further inhibits SARS-CoV-2 infection in human nasal epithelium in vitro.

Biomed Pharmacother. 2022 Jun;150:113058

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Serological testing for SARS-CoV-2 antibodies in clinical practice: A comparative diagnostic accuracy study

Allergy 2022 Jul;77(7):2090-2103

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Exposure to avian coronavirus vaccines is associated with increased levels of SARS-CoV-2-cross-reactive antibodies

Allergy 2022 Dec;77(12):3648-3662

Paniga Rudolf Sandra

Überprüfung des Biofire, FilmArray® BioThreat Panels für den Nachweis von RG3 Bakterien in Umweltproben

LS 2022-08

Rothenberger S, Hurdiss DL, Walser M, Malvezzi F, Mayor J, Ryter S, Moreno H, Liechti N, Engler O et al.

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Nat Biotechnol. 2022 Dec;40(12):1845-1854

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New Microbes and New Infections, Volumes 49–50, 2022, 101040

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Chemistry Division

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LN 2022-03 CLA/SIG

Solea AB, Curty C, Fromm KM, Allemann C, Mamula Steiner O

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Martz Severin

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Einfluss unterschiedlicher Synthese-Methoden und Reaktionsbedingungen auf die 2H/1H Isotopen-verhältnisse in Yperit verfolgt mit SNIF-NMR und Vergleich von 2H NMR Spektren von Phosphonaten mit und ohne 31P-Entkopplung

LN 2022-01 MRU

Menzi Benjamin, Curty Christophe

Anpassung des Kampstoffsets und Beschreibung der Methode für Sniff-Tests zur Prüfung von C-Nachweissystemen

LN 2022-01 MEN/CC

Menzi Benjamin

Detektionsversuche von chemischen Kampfstoffen mit Licht verschiedener Wellenlänge

LN 2022-02 MEN

Menzi Benjamin

Detektionsversuche von chemischen Kampfstoffen mit Licht verschiedener Wellenlänge – Part 2

LN 2022-03 MEN

Menzi Benjamin

Notfallübungen im C-Sicherheitslabor

LN 2022-04 MEN

Schorer Andreas, Siegenthaler Peter

Nachweis von β-Lyase Metabolite von Yperit in Urin mittels GC-MS/MS

LN 2022-02 ANDRS

Schorer Andreas, Siegenthaler Peter

Nachweis von O-Alkyl alkylphosphonaten und Methylphosphonsäure als G- und V-Stoff Metabolite in Urin mittels GC-MS/MS

LN 2022-05 ANDRS

Siegenthaler Peter

Implementierung von Messmethoden und Datenbanken sowie Etablierung eines Schulungsnetzwerks für die Agilent 8890/5977C GC-MS Systeme des Fachbereichs Chemie des Komp Zen ABC-KAMIR

LN 2022-04 SIG

CBRNe Protection Systems Division

Aebi Beat

CBRNE Monitoring. Zusammenfassung des Jahres 2021

LN 2022-01 AEB

Aebi Beat, Gloor Christian

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LN 2022-01 AEB/GLOC

Augsburger Reto

Leitfähigkeitsprüfeinrichtung NG. Erprobung Prototyp

LN 2022-01 AURE

Brenner Lorenz

Prüfstelle STS 0055. Konventionelle Druckstossprüfung – Grundlagenversuche und Ventilprüfungen im Sprengbunker

LS 2022-05

Brenner Lorenz

Explosionswirkungen – Druckstossausbreitung im urbanen Raum. Aufbereitung von swisstopo Daten für die Nutzung in APOLLO Blastsimulator

LN 2022-01 BL

Brenner Lorenz

Grundlagen Prüfverfahren STS 0055 – Druckstossprüfungen. Bestimmung neuer Forschungsstossrohrkonfigurationen für Messungen mit Ø500 mm und Analyse des Einflusses der Mediengrenze auf die gemessenen Druckstossprofile

LN 2022-02 BL

Brenner Lorenz

Anreissprüfstand für Kleinbelüftungsgeräte – Vorstudie Erneuerung Messkette und Ersatz Linienschreiber

LN 2022-03 BL

Brenner Lorenz, Zahnd André, Stähli Patrick

Aktualisierung der Blenden- / Düsenberechnungsmethode in der Prüfeinrichtung AIRFLUX sowie der Berechnungssoftware FLORES gemäss der Norm DIN EN ISO 5167

LN 2022-07 ZAAN

Novák Martin, Gloor Christian, Wicki Esther, Herb Dorothea, Schibli Adrian, Richner Gilles

Assessment of a novel, easy-to-implement, aerosolized H2O2 decontamination method for single-use filtering facepiece respirators in case of shortage

Journal of Occupational and Environmental Hygiene, 19:10-11, 663-675

Gurtner Markus

Partikelgrösse und Partikelform von Aktivkohle mittels Dynamischer Bildanalyse. Evaluation und Validierung des neuen Partikelgrössenanalysators CAMSIZER® P4 von Microtrac Retsch GmbH

LN 2022-01 GM

Gurtner Markus, Richner Gilles

Bestimmung des flüchtigen Massenanteils von Aktivkohle

LN 2022-02 GM

Richner Gilles

Einsatz der Gruppe ESIS während der COVID-19 Pandemie

LS 2022-06

Varanges Vincent, Caglar Baris, Lebaupin Yann, Batt Till, He Weidong, Wang Jing, Rossi René M, Richner Gilles, Delaloye Jean-Romain, Michaud Véronique

On the durability of surgical masks after simulated handling and wear
Sci Rep 12, 4938 (2022)

Tscherrig Dominic

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LN 2022-01 TDO

Meier Philipp, Zabara Mahsa, Hirsch Cordula, Gogos Alexander, Tscherrig Dominic, Richner Gilles, Nowack Bernd, Wick Peter

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Environment International, Volume 167, 2022, 107364

Wittwer Andreas, Richner Gilles

Prüfung der Aerosolabscheidung von Schutzmasken

LN 2022-1 WITA/GRIC

Zahnd André

Prüfstelle STS 0055 – Prüfverfahren Druckstossprüfung. Reproduzierbarkeit von mit dem Forschungsstossrohr generierten Druckstössen

LN 2022-01 ZAAN

Stähli Patrick, Zahnd André

Unsicherheitsberechnung Strömungswiderstandsprüfungen STS 0055

LN 2022-02 ZANN

Denzler David, Stähli Patrick, Zahnd André, Tillenkamp Frank

Forschungsprojekt Nr. 353009949: Bevölkerungsschutzrelevante Druckstossausbreitung. Jahresbericht 2022 zu Arbeitspaket 1

LN 2022-03 ZAAN

Stähli Patrick, Zahnd André, Tillenkamp Frank

Forschungsprojekt Nr. 353009949: Bevölkerungsschutzrelevante Druckstossausbreitung. Jahresbericht 2022 zu Arbeitspaket 3

LN 2022-04 ZAAN

Jenni Christian, Altorfer Tim, Düzel Sven, Brenner Lorenz, Zahnd André, Tillenkamp Frank

Forschungsprojekt Nr. 353009949: Bevölkerungsschutzrelevante Druckstossausbreitung. Jahresbericht 2022 zu Arbeitspaket 4

LN 2022-05 ZAAN

Zahnd André

Präzisierung und Weiterentwicklung der Methodik zur Vorbereitung der Prüflinge und Durchführung der Schlupfmessung

LN 2022-06 ZAAN

NBC Arms Control

Brackmann M, Gemünden M, Invernizzi C, Mogl S

Assessing emerging technologies from an arms control perspective

Front Res Metr Anal. 2022 Sep 12;7:1012355

Urbina F, Lentzos F, Invernizzi C et al.

Dual use of artificial-intelligence-powered drug discovery

Nat Mach Intell 4, 189–191 (2022)

Urbina F, Lentzos F, Invernizzi C et al.

A teachable moment for dual-use

Nat Mach Intell 4, 607 (2022)

Urbina F, Lentzos F, Invernizzi C, Ekins S

AI in drug discovery: A wake-up call

Drug Discov Today. 2023 Jan;28(1):103410

Wirz Christoph

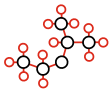
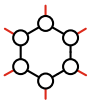
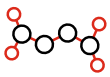
Verifying the absence of nuclear weapons in a field exercise

LN 2022-01 WIC

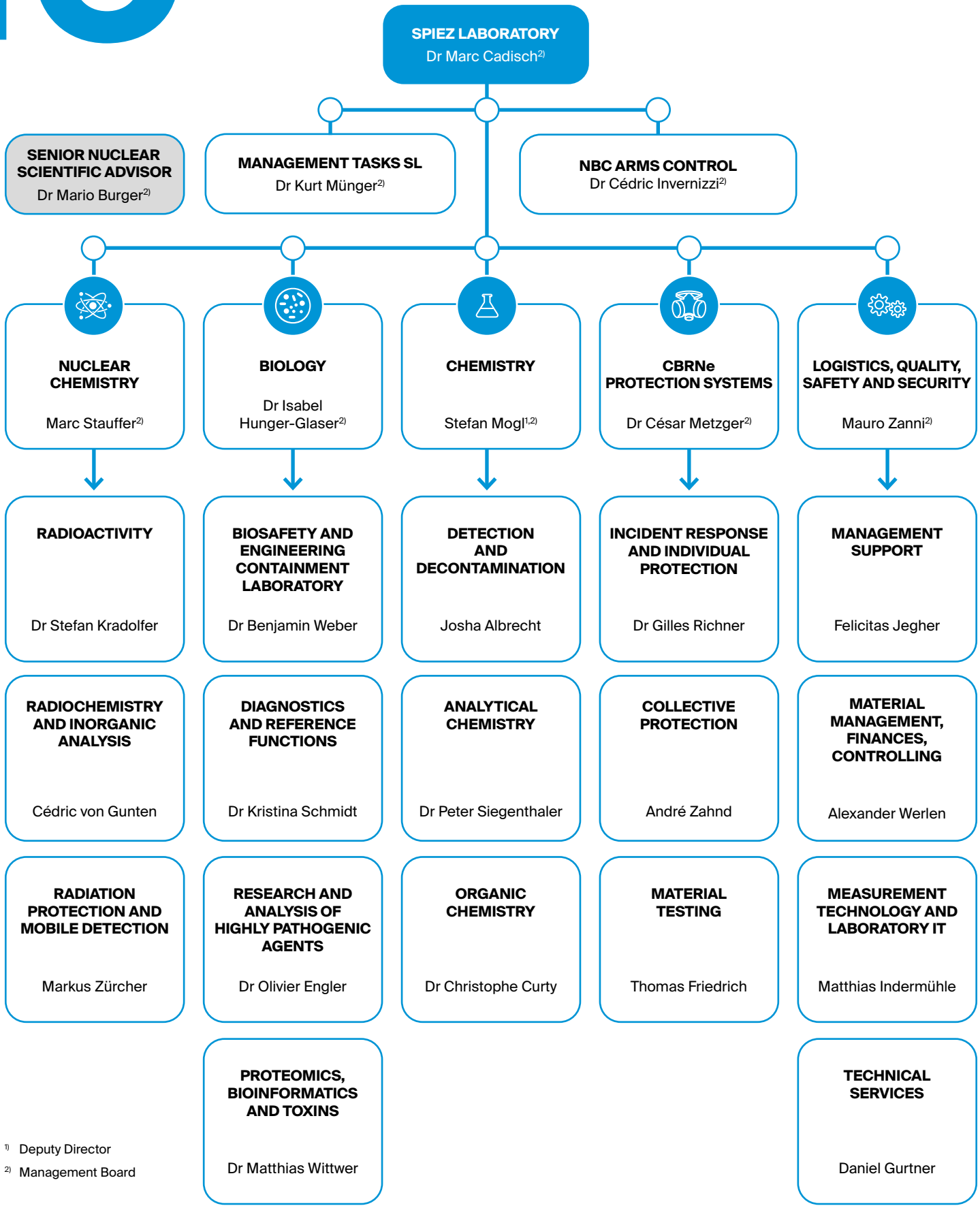
14 Accredited laboratories

Participation in External Quality Assurance (EQA) Exercises October 2021 – September 2022

Testing Laboratory	*Number*	*Partner*	*Test type*
STS 0028	**Testing laboratory for the determination of radionuclides and elemental analysis**		
	1	University of Wageningen (NL)	– International Soil Exchange (ISE)
	3	ielab (ESP)	– Potable water – Sea water
	1	AQS Baden-Württemberg (GER)	– Potable water
	2	International Atomic Energy Agency (IAEA)	– PT ALMERA – PT Seawater RML
	1	Institute of radio-physics / Institut de radiophysique (IRA) / Federal Office of Public Health (FOPH)	– EQA Gamma spectrometry
	1	National Emergency Operations Centre and Incident Management (NEOC) / Federal Office of Public Health (FOPH)	– In-situ Gamma spectrometry comparative measurement
STS 0054	**Testing laboratory for the detection of biological agents**		
	3	Public Health England (PHE) (UK)	– Analysis of potable water
	2	INSTAND (GER)	– Molecular biological detection meth-ods bacteriology: *B. anthracis, F. tu-larensis, C. burnetti, Brucella spp*
	1	QCMD (UK)	– Molecular biological detection methods bacteriology: Pilot Study *F. tularensis*
	2	World Health Organization (WHO)	– Molecular biological detection methods virology: EQA SARS-CoV-2 – Molecular biological detection methods virology: RCPAQAP Viral Haemorrhagic Diseases
	3	United Nations Secretary-General's Mechanism (UNSGM)	– Molecular biological detection methods virology: Laboratory exercise disease X testing (unknown virus) – Molecular biological detection methods virology: EQAE RefBio viruses – Molecular biological detection methods bacteriology: EQAE RefBio bacteria

STS 0019	**Testing laboratory for the analysis of samples for the presence of chemical warfare agents and related compounds**		
	2	Organisation for the Prohibition of Chemical Weapons (OPCW)	International EQA tests organised by the OPCW in the analysis of chemical warfare agents in environmental samples (OPCW Proficiency Tests): – 50. OPCW Proficiency Test (October/ November 2021) – 51. OPCW Proficiency Test (May 2022)
STS 0022	**Testing laboratory for adsorbents and breathing apparatus filters**		
	1	Spiez Laboratory	– Comparative measurements on HEPA filters 180 m^3/h in accordance with EN 1822 und norm-like in-house methods
	1	NATO	– Sorption performance of activated charcoal for Chloropicrin in accordance with (new) AEP-73
	1	European Defence Agency (EDA)	– Sorption performance of activated charcoal for Chloropicrin, HCN, H_2S
STS 0036	**Testing laboratory for Polymers and Rubber, and for the Protection Performance of Polymers, Rubber and Textiles against Chemical Warfare Agents**		
	8	German Reference Bureau for Interlaboratory Tests and Reference Materials (Deutsches Referenzbüro für Ringversuche und Referenzmaterialien GmbH, DRRR) (GER)	– Tensile deformation test rubber – Compression test rubber – Compression test foams – Tensile test coated textiles – Width and thickness of test specimen – Izod-impact bend test – Artificial weathering, colour change – Artificial weathering, change of tensile properties
	2	TESTEX AG	– Strip tensile test on textiles – Tear resistance test on textiles
STS 0055	**Testing laboratory for NBC protective material as well as equipment and installations for use in protective structures**		
	0	No EQA exercises	

15 Organigram



1) Deputy Director
2) Management Board

01. 01. 2023

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Department of Defence,
Civil Protection and Sport DDPS
Federal Office for Civil Protection FOCP
SPIEZ LABORATORY