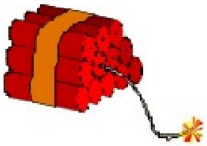


Sektionen för Detonik och Förbränning, SDF
The Swedish Section for Detonics and Combustion
anknuten till/affiliated with The Combustion Institute
www.sdfsweden.se info@sdfsweden.se

SDF Newsletter 2023:2 English

The Section for Detonics and Combustion, SDF, is a non-profit association with the aim of bringing together people in the science and technology fields of detonics and combustion for information exchange and cooperation aimed at promoting education and scientific research within these fields.
SDF is affiliated with The Combustion Institute, CI, which is an international, non-profit, educational and scientific society in combustion science with 13 different areas.
SDF supports the Sprängtekniska Muséet (Explosive Technology Museum) in Karlstad, which shows the history of the Zakrisdalsverken and preserves munitions knowledge and training in the field of explosives.
Membership of SDF is free, but in order to ensure continued business, SDF would be happy to accept a voluntary contribution of SEK 100 or more to Plusgiro 196 69 42-3.

The Chairman's column
Another year has passed in SDF history. We will probably turn 70 next year; it is a little unclear but we can at least trace our history back to 1954. SDF was then a special section within the National Committee for Mechanics which belonged to the Royal Academy of Sciences. Neither commitment nor funding was a problem at this time. Sweden had learned a hard lesson during the Second World War and defense and the defense industry were expanded, as well as basic education and academic education. There were many and large companies in the defense industry and Sweden had several successful explosives companies and pyrotechnic industry. These generously contributed both working time and financial resources to SDF's activities. Our first chairman, Carl Hugo Johansson, was a professor of physics from KTH and head of research at Nitroglycerin AB. The next chairman, Allan Wetterholm, also became head of research at Nitroglycerin AB and he had in his luggage a Techn Lic degree from KTH. The third chairman was Jan Hansson, Ph.D. in chemistry at FOA. All of them could freely devote themselves to SDF affairs in their work.

This liberality was curtailed in the course of time to basically cease completely at the end of the Cold War around 1990. Knowledge was initially still there, but financing had to be solved in other ways. Over the years, SDF had arranged a lot of meetings, seminars, colloquiums, conferences, etc. Participation fees from these became the new source of income, but when more and more dropped out due to age or transition to other activities, this income also ceased during the 2010s.

The SDF has so far never collected membership fees from its members, but lived on the old income. These have now been used up and something must be done. We have tried to get sponsorship from companies in the industry, but with poor results. So far, only Cesium AB sponsors us by paying for our website. An alternative could be that we are forced to charge a membership fee.

Since most people active in the industry were employed during the Cold War, much knowledge has been lost in recent times. Together with the Security and Defense Companies (SOFF), we tried within the framework of the Peace

Technology Project to engage universities and colleges to once again train students in our field. The interest from UoH was, however, very limited and when the SOFF project manager for the initiative changed jobs, this also fell through. *Much ado about nothing!* However, I am convinced that Swedish education in the field is required. With a doubled defense budget and membership in NATO (hopefully), many more experts are required in the SDF field of activity.

After the previous secretary's death in 2020 and restart of the business with new statutes, etc. in 2021, the business has started again. So far in the form of seminars via digital meetings and study visits. Our new secretary deserves all the credit for so diligently accomplishing this. However, we are limited in the absence of both money and committed members. We didn't even manage to get an election committee together at the last annual meeting and now it's almost time for a new annual meeting. We need more younger members who get involved in the association's activities. Register yourself as interested in joining the board or carrying out other parts of SDF's activities. If you are too modest to run for office yourself, let us on the board know about suitable candidates.

Merry Christmas and a Happy New Year!

/Ola Listh Retired senior engineer from FOI and Chairman of SDF

A national imperative – rebuilding energetic materials science and technology capability

For the past 60 years I have been on a journey through the world of energetics. But like all journeys it starts from home and for me that is in the United Kingdom. We have a proud tradition in synthesis, formulation, characterisation and application, and our understanding of the fundamental science provides a level of confidence that underpins everything we do in energetics.

My journey started in the 60s in one the UK’s major ordnance factories where most of the UK’s triple based gun propellant and much of our double base rocket propellant was manufactured along with their main ingredients, nitrocellulose, nitroglycerine and nitroguanidine. Nearly all the UK ordnance and explosives needs were met by a network of government ordnance factories manufacturing everything from tanks, guns, and ammunition to nearly all the UK’s propellants, explosives, and pyrotechnics. Years of underinvestment in these facilities led them becoming inefficient and expensive and, in the 1990’s, resulted in their privatisation and ultimately to the closure of much of the UK’s energetics manufacturing capacity.

Underpinning the ordnance factories were an extensive network of government research and development establishments that played a major role in the design of ordnance systems and in the development of new materials and manufacturing processes. Many of these establishment were to either close or be privatised. The net effect was a major contraction in research and development capacity and capability. This impacted the UK university sector that had contributed much to the UK’s fundamental explosives science capability. The throughput of research students was reduced as the contracting enterprise was not inclined to recruit.

The overall effect of these changes was to significantly reduce the number of scientists and technologists working on energetics in the UK. This had an impact on the UK’s ability to develop and maintain relevant standards and to regulate

explosives safety given that the ex plosives safety organisations traditionally drew their expertise from that government network of factories and research establishments. Publications from the UK in this journal [Propellants, Explosives, Pyrotechnics (PEP)] represented around 8 % of total publications twenty years ago, it is now just around 2 %. Other publications and conference proceedings have shown similar decline.

As my generation retire and leave the stage there is a realisation, exacerbated by recent world events, that the health of our national energetics enterprise needs to be restored. A resurrection is underway with government, industry and academia coming together to rebuild our capability and capacity. Like all rebuilding, we need sound foundations which require people, technologies, knowledge, and facilities. A Centre of Excellence in Energetic Materials (CoEEM) has been created by key national stakeholders with the explicit aims to provide, firstly, top level leadership to the UK energetics community and secondly, to build the depth of expertise, and hence critical mass of people, to support the country's energetics enterprise. Good progress has been made with a strategic panel from government providing direction and oversight of the Centre's activities. A technical director and technical leads have been appointed to cover all the key specialisms required by a healthy energetics enterprise. These include groups working on synthesis, formulations, processing, manufacture as well as characterisation, detonics, modelling and hazard testing. Each technical lead has a clear set of deliverables as agreed by the strategic panel of CoEEM.

With regards the development of people, a Sector Skills Strategy Group comprising corporate members from the UK's Institute of Explosives Engineering is leading on the development and sustaining explosive skills at all levels. Undergraduate programmes, apprenticeships, and postgraduate programmes are in place to rebuild that critical mass of people. Recruitment of new blood is underway but retention is an issue. Experience must be built, so it is important that we keep the people we recruit by offering exciting and interesting jobs, competitive remuneration, and career prospects. We need to grow, not just the numbers of people, but to accumulate the experience required by the sector. It is imperative that we recruit and retain the brightest and best.

All if this requires money. Our industrial capacity needs to be restored and both industry and government are responding to the investment challenges required. New technology is being embraced as are new ways of working to get things back on track. Building the sound science and technology base also requires investment in equipment, laboratories, and test and evaluation infrastructure. Universities also need to respond and need new funding sources to build their teaching and research activities. There have been some advances, but more is needed.

Overall, UK energetics has turned a corner from years of decline towards a resurrection. My hope is that this is manifested in an increase of quality submissions to this journal. I'm excited by the prospect.

Professor Ian Wallace
Cranfield University, United Kingdom.
Email: i.g.wallace@cranfield.ac.uk

Ref.: Wallace I, **A national imperative – rebuilding energetic materials science and technology capability.** *Propellants, Explos., Pyrotech.* 2023;48:e202300190.
https://doi.org/10.1002/prep.202300190
wileyonlinelibrary.com/journal/prep

The presentation from the seminar "Gyttorp through my eyes"

Rolf Hultman and Krister Nordh held a seminar on 2023-10-26 about the history of nitroglycerine and Nitro Nobel history in Gyttorp.

The presentation in Swedish can now be downloaded from SDF's website www.sdfsweden.se > "Aktiviteter". Thank you Rolf and Krister.

SDF Program 2024; www.sdfsweden.se/history/default.sv.php

Seminars

- Suggestions for topics or seminar presenters are welcome

Study visits that SDF is working on implementing at some point in the future:

- Orica in Gyttorp

- FOA shock wave stub IV and the Swedish Armed Forces' dog service unit (FHTE) in Märsta

- Hanssons Pyrotekniska in Lindesberg

- Kiruna with a visit to Esrange, LKAB's tourist mine/[Kimit], ???

- Epc-Groupe at Hugelsta firing range, Cesium AB, Vingåkersverken

- FOI Grindsjön

- ??? ;Visit to your company/institution ?

Linkedin ”SSC - Swedish Space Corporation” - Milestone in test of new rocket motor

Red Kite:
Total mass: 1180 kg
Propellant: 915 kg
Diameter: 559 mm
Length: 3340 mm
Thrust: 226 kN
Burn time: 13 seconds

At the beginning of August, two successful tests were conducted of the Red Kite rocket motor, developed in Germany by Bayern-Chemie (LFK Germany / MBDA Group) and German Aerospace Center (DLR) Moraba. If the upcoming test flight goes as planned, the first rocket launch with a Red Kite motor will take place as early as February 2024.

Availability of rocket motors has been a challenge for many years since almost all motors today are imported from North- and South America. Therefore, it is of extra importance for SSC that, after the successful tests, we will have access to a civilian European rocket motor.

Red Kite is developed for micro gravity research and provides equivalent performance to the Brazilian VSB-30 motor. It will be able to cover a wide flora of different missions and can be combined with other motors as well as with itself, to be used in various combinations with multiple rocket stages.

During the tests carried out at the Esrange Space Center in early August, the performance was studied at -20 degrees Celsius and at +50 degrees, all to see how well it works under a wide range of different conditions. The performance was also tested under different simulated pressure conditions.

The new motor will also be safer to handle than many other solid fuel rocket motors. For example, the ignition device will not be as sensitive to interference, which increases the safety during both transport, storage and loading.
- Everything is not finished yet, but it was a good result and a successful test we did at Esrange. Our customers were very satisfied with the service we could offer, says Marko Kohberg, manager Rocket and Balloons at SSC Esrange.

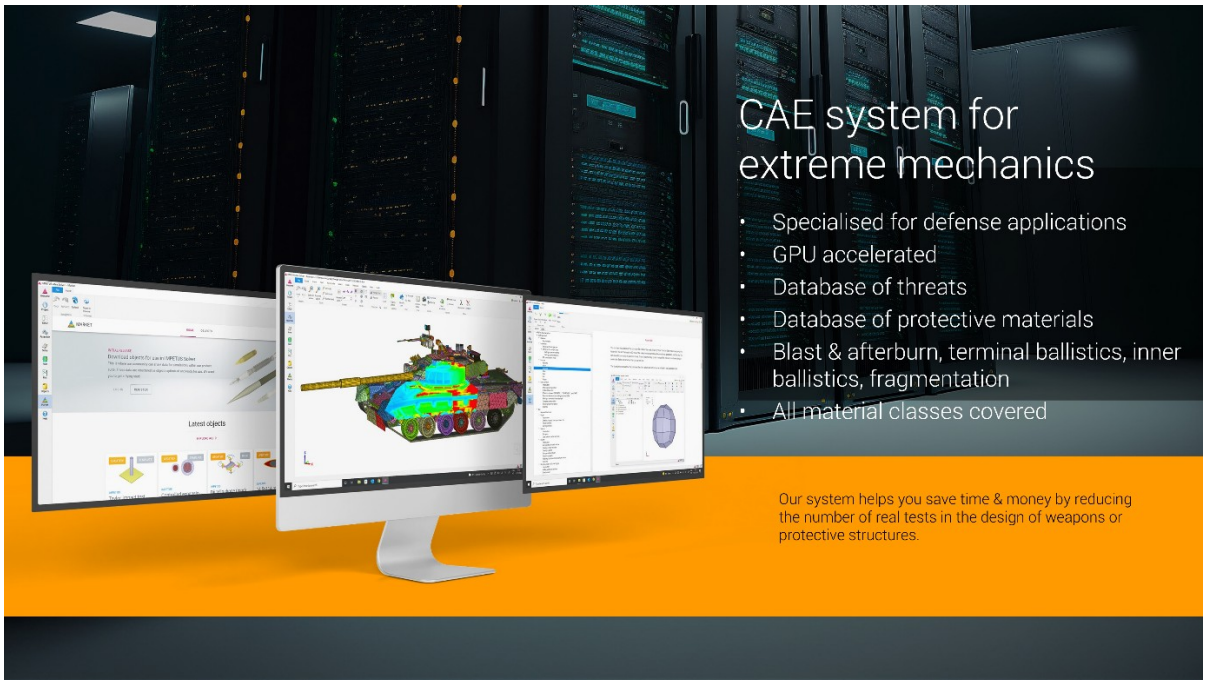
In November, a first test flight will be carried out in the Norwegian Andöya, and if everything goes according to plan, the first sharp launch with a Red Kite motor from Esrange will take place in February next year.
- We are very happy about the collaboration with DLR Moraba and Bayern Chemie who choose Esrange in a very important step in developing and testing their motor, says Marko Kohberg.

IMPETUS Solver - Finite Element Modeling with Explicit Time Integration

IMPETUS Afea is a Norwegian-Swedish company, founded in 2006 by Arve Grønsund Hanssen, with offices in Flekkefjord and Huddinge. The company develops the simulation tool IMPETUS Solver. In 2007 there were two of us, Arve in Flekkefjord and I in Huddinge. We worked as consultants, mainly with calculation tasks for the Norwegian oil industry. An additional resource was my father in Borlänge. He built various crazy machines for mechanical testing (example in the picture below). Good simulations require good material data.

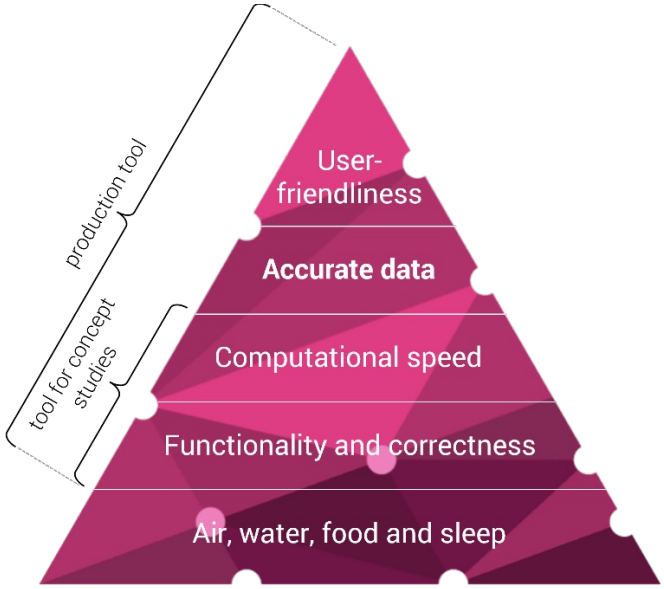
Wear tester for testing hardened steel used in expansion of liner pipes

We relied on commercial software for the assignments, but had an idea. I came up with an innovation with the potential to revolutionize a certain narrow niche in the field of computational mechanics: Finite Element Modeling with Explicit Time Integration. In short, it is usually called "Explicit FEM". It is a method that in the simplest possible way solves the nonlinear, coupled partial differential equations that are supposed to describe the physical process you want to study. Easiest possible because you extrapolate in time and thus avoid an implicit solution of large nonlinear equation systems. The price you pay is an uncertainty in the size of the numerical errors, as well as a brutal inefficiency in handling slow processes. Explicit FEM has its strength in modeling dynamic processes, where materials are subjected to large and rapid deformations. The largest market is the automotive industry, where simulation is used, among other things, to predict and improve vehicle crash safety. However, the methodology was initially developed for modeling different types of weapon effects (eg terminal ballistics and explosive loads). Our major innovation was a new type of element (building blocks) that would make the simulations both more stable and more accurate. A first pilot project, where we developed an experimental program code, showed that the concept worked better than we dared to dream. The fact that, after the initial success, we dared to bet everything on one card and focus entirely on our future product was partly due to the financial crisis. The oil and gas industry cut back on its investments and consulting assignments became both fewer and less lucrative. Time was freed up to work on what would later be named the IMPETUS Solver. Today, 16 years later, we have a complete software system for "weapons effect simulations" and customers who work with terminal and interior ballistics, development of armored vehicles, shock wave propagation, RSV, underwater explosions and general structural response.



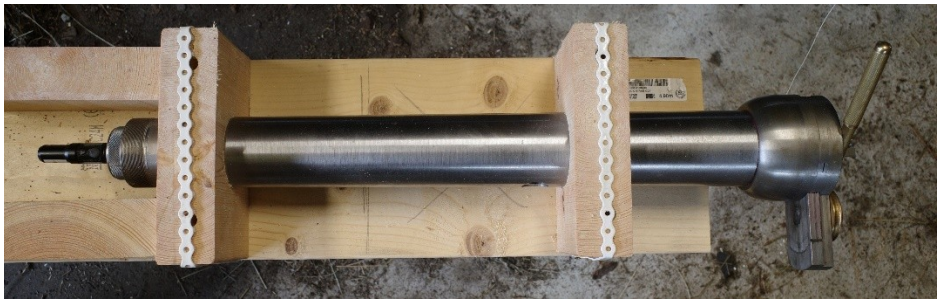
IMPETUS Solver

A relatively complete system, with the solution methodology in place, has made clear the next step on the calculation engineer's ladder of needs: **access to good material data**. Lack of this is by far the biggest limitation for our customers, in their quest to produce quantitative simulation results with high precision. For example, it is difficult to draw conclusions about a protective structure without a credible description of the strength and breaking properties of the materials involved.



The calculation engineer's ladder of needs

This is where we now put a lot of focus. Our understanding of the entire chain of **physical assumptions → mathematical formulation → numerical algorithms → program code → simulation** results gives us a unique position. It is often easier for us than for our customers to design experiments that supply the necessary inputs to the simulation models. We therefore continue to carry out mechanical testing and have also built our own small ballistics lab in Flekkefjord. It is, in all its simplicity, a very valuable component in our endeavor to offer calibrated models to our customers.



Picture from the ballistics lab in Flekkefjord

In Norway, where we have a strong base of users, IMPETUS Afea has become something of a focal point for industry and government actors in the defense sector. We organize meetings and run projects where we discuss technology and move development forward together. The common feature is that everyone uses IMPETUS Solver as a tool. In Sweden, we have not come as far, but we hope to be able to do more good here as well.

/Lars Olovsson https://www.impetus.no
Technical manager at IMPETUS Afea and newly joined member of SDF Sweden

Information from SaferWorld International AB: Protection against the effects of an explosion

In the defense- and explosive industry, it is natural to design protections and construct appropriately to protect people and property against the effects of explosions in case of accidents. Years of research and development, targeted safety work, and extensive experience, from both successful and unsuccessful attempts, to enhance safety has led to a construction method that minimizes risks for both employees and the surrounding environment. One can only hope that this knowledge is preserved and will not be forgotten in today's rapid technological development.

But what about in the civil society? Do people in general have any knowledge of what happens in the event of an attack involving explosives? Other than what the press reports as "loud bangs"? The Swedish Civil Contingencies Agency (MSB) has produced an excellent pamphlet titled "Protection in Public Environments", which describes various threats in today's society and the consequences of different scenarios. Unfortunately, it seems that not many people are familiar with this publication.

When inspecting a city´s safety scenes, it is striking how little interest there seems to be in general protection in the public environments. Buildings with massive glass surfaces are constructed where large gatherings of people are planned to take place. Often with litter bins in direct proximity to the glass facades. A plastic bag with unknown content next to a building triggers reactions, consequentially the bomb squad is called in. However, a bomb in a litter bin is not visible and can be detonated remotely.

SaferWorld International AB develops and sells various products to supress explosions, including bomb-proof litter bins. As part of our interest in peace technology, we also develop destruction equipment to dispose of old ammunition and explosives of various types.

SaferWorld International is a Karlstad-based company at the forefront of security technology. We offer solutions and products that provide protection against explosions and other types of external threats. The purpose of our product range is to protect people and environment, both in everyday life and in the most critical situations.

Led by founder and CEO Jonny Olsson, we have 50 years of experience in the defense- and explosives industry. The result is reliable products that contribute to

a freer society where people feel safer in their daily lives, while also protecting lives and property in the event of a serious threat.

The security landscape, both regionally and globally, is constantly changing, with new types of threats emerging all the time. Modern and innovative security solutions are therefore key to enhancing safety and increasing security for all of us. That is why at SaferWorld International, we allocate a significant portion of our resources to developing products that are suitable for today's and tomorrow's security landscape.

Explosives as weapons

When it comes to Improvised Explosive Devices (IED), it is common in Sweden, and the rest of the western world, for it to be placed in a bag or some form of container, which is then thrown into a litter bin by the perpetrator. He or she can pass by completely unnoticed, pretending to dispose litter, and calmly leave the scene before the explosive detonates, without drawing suspicion.

Explosives - dangerous and unpredictable

Explosives can cause significant devastation. Even a very small amount of explosive material can impair a person's hearing. Depending on the explosive power, the air pressure wave itself can be lethal. At the same time, fragments from the explosive device and the surrounding environment, such as shards of glass and metal fragments, can cause damage at considerable distances from the actual detonation. An explosion also generates a great fireball with intense heat, that can cause burns and ignite fires.

ESLB is our series of explosion suppression litter bins. With patented design and construction, they can withstand powerful detonations and provide protection against air pressure waves, fire, and fragments. An important aspect is that these products are designed to blend seamlessly into the existing environment. By looking like regular litter bin, they can increase the level of security without creating unease due to their appearance.

For all types of businesses and environments

Our litter bins are developed with the aim of easily replacing existing non-explosion-proof litter bins in all types of businesses and environments. From small offices or reception areas to critical buildings and facilities such as nuclear power plants and hospitals. Our range includes models with different explosion capacities and waste volumes, with one or two bins, with or without covers, and with various options for emptying and handling.

At SaferWorld International, our vision is to make the world a safer place, on a global scale. Thanks to innovative and high-tech designs, our products maintain an exceptionally high standard in terms of quality and reliability. Each product undergoes rigorous testing, naturally under realistic conditions, to meet the high standards we set for them.

As a property owner, security consultant, or designer, you now have the opportunity to enhance the level of security in your specific operation. At our

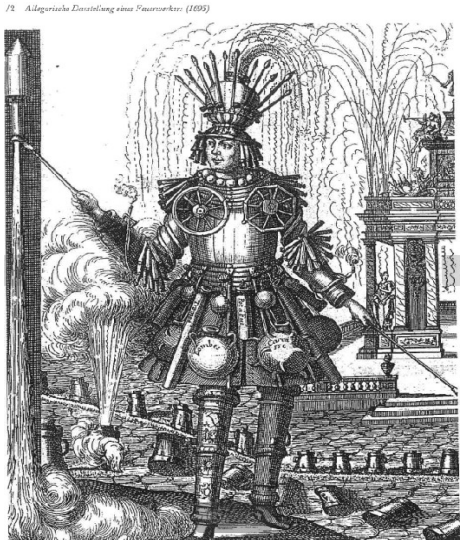
headquarters in Karlstad, we provide storage facilities and a showroom where we can demonstrate our products and ideas.

Do not hesitate to contact us if you are interested in a more detailed presentation.

Welcome to a SaferWorld
www.saferworldintl.com

Sofia Scott, SaferWorld International
sofia.scott@saferworldintl.com

Translation and editing this English version: **Bo Janzon**, aided by Google Translate


Allegorische Darstellung eines Fuerwerkes 1695

Editor of SDF Newsletter: Håkan Ljungqvist Secretary hakan@gumba.nu
Google Translate has been used for some of the articles.