### *1.1. Background*

On April 26 at lunchtime, 112 calls are received to SOS Alarm/LC about fire/smoke development from a larger container that contains lithium-ion batteries and is located indoors at a company in Sisjön's industrial area. When the emergency services arrive at the property continued fire/smoke development is noted, however, the company's staff have managed to move out the container from the building.

## 3 INVOICE

### *3.1 Description of the accident scene*

The incident occurred in the Sisjön industrial area located in Västra Frölunda, Gothenburg. One area with many large shophouses and smaller to medium-sized industrial properties. It can expected to be a lot of people in the area for large parts of the day, even people without area or local knowledge. The area is bounded by a traffic route to the north, a golf course to the east and various types of residential development in the south and west. The current location was in the east the part of the area and the wind direction were at the time favorable in relation to the big ones the business houses and residential buildings that were mostly south and west of the accident site.

Current building and its nearest neighbours were smaller industrial and office buildings in one
or two floors of building class (BR2-3). The buildings were separated by paved surfaces too setup, loading/unloading and parking. There was a certain level difference between the different ones the operations. The building in question was in class BR2 and was a combined warehouse/manufacturing and office building on two levels where the warehouse part was on one level of the entire building height. Next to the warehouse/manufacturing part were two larger gates for ingress and egress. In the building had in addition to the normal fire protection in the form of indoor fire hydrants, manual fire extinguishers and smoke hatches, also a burglar and fire alarm with cameras.

*Figure 1 shows an overview of the area. Source Land Survey*

#### *3.1.1 Description of the battery energy storage*

Inside the warehouse part of the building there was, among other things, a 20-foot uninsulated steel container set up on wheel. Half of the container contained a battery energy storage consisting of many battery cells assembled into larger battery strings. There were ten battery strings connected to a large battery unit with an energy content of up to 875 kWh and which weighed about 9 tons. The other half of the container was empty. Battery energy

storage was below construction and not commissioned, i.a. a software for the batteries was not supplied from the battery manufacturer. The batteries were charged to a delivery voltage but were not fully charged.

An air/liquid cooling system with the purpose of cooling the batteries during operation was fitted in the container but not commissioned or connected to mains voltage. The container's doors on one the gable was open. In the middle of one long side of the container was a water inlet with a coupling that fit the hoses of the emergency services. The pipe then went up inside the container over the battery unit.

### *3.2 The course of the accident*

Just before lunch, staff in the warehouse discovered thin white smoke coming from the far side of the container part where the battery unit was located. The staff on site raised the alarm internally about the incident and immediately begins to move the container out of the premises using the wheels that the container stood on and a truck. In connection with this, the emergency services were also alerted via SOS alarm.

The white smoke increased and began to fill the storage area. The container's location inside the room was just inside one of the gates but it had to be turned 90 degrees to come out through the gate. During this part of the move, the container came off its wheels set up, which made it difficult to move the container out. When the emergency services arrived at the site, the staff had managed to get more than half the container out through the gate and pretty soon after that everything was out and the extinguishing effort began.

#### *3.2.1 Accident causes*

RSG has received two investigations from the actors involved. One from the company in Sisjön and one from the international battery supplier. Both investigations point to the the most likely reason is that when the batteries' cooling system is pressure tested after installation, it has a leakage occurred inside a battery cell which in turn caused a short circuit with thermal rush as a result. The conclusions from both investigations can be read in their entirety at original language (see Appendix 1 and 2).

#### *3.2.2 Consequences of the accident*

Several people from the company inhaled varying amounts of fire smoke during the earliest part of the fire progress. However, no one needed emergency medical care. The building and its inventory was to a lesser extent smoke damaged during the early part of the accident.

The container in question with its contents was completely destroyed. An unknown quantity contaminated extinguishing water flowed out, the largest part via the storm water wells that were on the courtyard. The building's facade was affected by heat, extinguishing water and smoke. The the investigation has no information on the economic or psychological consequences of the accident if.

### *3.3 Execution of the rescue operation*

At 11:37 a "big alarm, fire in battery container" went off at the Frölunda fire station, which was the nearest station in time. They rushed out with rescue unit (RE) and height unit (HE) there HE is immediately turned over by the control center (LC) to be exchanged for water unit (VE). Mölndals fire station was alerted at the same time and they also went with RE and VE. During the drive the staff formed the image that it was a container containing smaller batteries, possibly a collection container for used batteries. They were reached by the information that personnel on site try to move the container out into the open. The force leader in RE from Mölndal advised that they used a spare car that did not have a fire extinguisher. Also operations leader (IL) from Mölndal was alerted. Arriving at the venue (at 11:44), Frölunda received a meeting that showed him in those behind the building. There they saw that the container was halfway out and the company's staff worked on getting it out

completely, which they soon after succeeded in doing. The container was now outside the building and the fire personnel saw that the door on the end of the container was open there white smoke came out. Personnel from the company described the contents of the container to the force leader and that there was an entry for extinguishing water on the long side of the container, this to be able to sprinkle and fill the container with water if necessary and thus destroy all batteries inside the container. This entry was connected but not started.

*Figure 2 shows the container early in the operation. Source RSG*

At the same time, the rescue unit was established at the entrance to the farm. The open door on the container was closed and they prepared to cool and inert the smoke gases inside the container with a fire extinguisher. Cooling/inerting of the flue gases began and the attack was made centrally on the long side of the container high up so as not to risk penetration as well the batteries.

IL was in the car when he received the alarm (at 11:41). He contacted the command center and asked them to produce the internal guideline concerning Lithium-ion batteries. The information that he received from the LC was that inhalation of the fire smoke was seen as the main risk and that a fire can be very difficult to extinguish. During the drive he requested also Unmanned Aerial System (UAS) from Lindome fire station. IL arrived at the scene of the accident at the same time as RE from Mölndal (at 11:50) and received more information there when that concerned the size of the batteries, where, among other things, it appeared that the entire battery weighed about nine tons.

Cooling/inerting of the battery and its surroundings had begun with cutting extinguishers and with it you shot diagonally upwards towards the roof of the container to avoid hitting the battery. IL continued as rescue manager (RL) and in connection with a short management meeting, about 4 – 5 minutes after cooling with cutting extinguishers started, a strong one occurred explosion that deformed the container and where the doors on one short side of the container flew open.

No people were injured in the explosion. Immediately everyone was ordered to back away and that the continued work would take place under cover. Favorable winds meant that one could work with the wind at your back.

*Figure 3 shows a clip from a film that captured the explosion. Source current company.*

*Figure 4 shows smoke development and work from a protected position. Source RSG*

Zoning was determined and communicated and where compressed air equipment would be used in hot zone and a so-called half mask in the hot zone. They were evacuated with the help of the police adjacent building and the people who stayed in properties further away but still in wind direction were informed to stay indoors.

In connection with the explosion, the development of smoke increased significantly and they could now see openings flames from the batteries. The new orientation meant that now resources were also put into limit the fire's spread to adjacent buildings. This was carried out with cooling of facades and roofs with water from jet pipes and water cannons.

After dialogue between RL and RIL, RIL went to the scene of the accident. IL from Lundby fire station was inside LC and was there helping with staff work. IL contacted i.a. the rescue leader and handed over contact details to a couple of people who could contribute knowledge/information. Among other things, what was conveyed to the scene of the accident was that there was no point in cooling the batteries as long as the temperature stayed below a certain one given temperature. Applying water in that situation only created further problems with rose quantities of contaminated extinguishing water.

RIL came out to the scene at about 12:30 and continued as RL and IL became large sector manager. RL decided to request an Important Public Notice (VMA) to warn people about it the suspected dangerous fumes. The request came in to the LC and was then handled further by the guard commander (VB) as instructed. VMA went out at 1:15 p.m.

The work progressed for a couple of hours where, among other things, they checked adjacent areas properties. Proactively, a number of gas cylinders were moved and an hour or so later they were moved also the container away from the vicinity of the facade with the help of a truck.