IKON19

INSTRUMENT INSTALLATION REPORT FOR IKON19

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1A. HIGH LEVEL INSTALLATION SCHEDULE

The access dates for instrument halls are according to the baseline schedule, and no delays are foreseen from SEC/CF. The dates are January 2021 for D03 (LOKI, TBL) and June 2021 for D01 (ODIN, DREAM & ESTIA). Access to E01 & E02.1 buildings was given according to schedule, August 2019. The instrument in-bunker access has a forecasted delay of about 6-7 months, due to delays in Target (portblocks, light shutters and NBPIs). NSS and Target have been working hard to find ways to mitigate the delays by optimising the installation sequence and minimising the constraints between Bunker and Target installations. In practice this means that NSS can continue with the Bunker installations (no foreseen delays at this point) independent of Target delays. This is however only valid up to a certain point, and NSS cannot complete the Bunker installations and start the in-bunker access for instruments before the inserts have been installed. The delivery plan of the NBPIs are discussed regularly with Target, but there are no confirmed dates as of today.

With the rolling wave plan, Target R-BOT (and hence ESS BOT) is forecasted to March 2023, whilst Bunker R-BOT is forecasted to January 2023. The rolling wave plane will apply until ESS and Council are ready for a rebaseline, Q42020 or Q12021 according to Project Director Mark Anthony.

At the schedule workshops with First 8 Instruments (Aug 26th) the mitigation strategy based on splitting the in-bunker access into 4 areas North, South, East and West (instead of D03 and D01) was discussed and agreed. This mitigates several months of delay for the first 3 sections, and hence relieves pressure on the critical path and allows many of the instrument to proceed as planned. Target will complete its installations (inserts, Light shutters etc) in a specific section, after which instruments will have access. Table 1 shows the forecasted access dates.

Table 1 gives details about the access milestones.

Building/Area Access	Baseline	Forecast	Comment
E01 full access CSPEC, BIFROST, MAGIC, BEER	2019-08-15	Done.	*NMX approved to move ahead due to low activity in the E-buildings*
E02.1 parallel access CSPEC, BIFROST, MAGIC, BEER	2019-08-15	On time	
D03 Instrument Access (parallel) LOKI, TBL	2021-01-18	On time	*Hall crane operational 2021-02-15, but forecasted to be ready Jan 18th 2021.*
D01 Instrument Access (parallel) ODIN, DREAM, ESTIA	2021-06-03	On time	*Hall crane operational 2021-07-26, but forecasted to be ready June 3rd 2021.*
In-bunker access North Section (LOKI, TBL)	2021-07-09	Sept 2021	*Based on Targets rolling wave plan, and the input from Instrument schedules.* *Dates aligned with the agreed plan of 4 in-bunker section.*
In-bunker access South Section (ODIN, DREAM)	2021-08-11	Oct 2021	
In-bunker access East Section (ESTIA)	2021-08-11	Nov 2021	
In-bunker access West Section (CSPEC, BEER, MAGIC, BIFROST, NMX)	2021-07-09	March 2022	

1B INSTALLATION COORDINATION

Instrument installations need complex coordination of resources involved in the field, provided from different installation teams belonging to NSS, In-Kind Partners, ESS central groups, framework contracts, commercial suppliers involved in both manufacturing and installation works, and so on. In these articulated scenarios, it is crucial to have a proper understanding of the "ESS ways of working", which is very well defined at this point in the construction project, in terms of roles and responsibilities of the different stakeholders involved. Especially in regards to the existing differences between the Installation Coordinator (IC), the Area Coordinator (AC) and Installation Package Leads (IPL). The IC & AC are provided by the ESS Central Installation team, whilst the IPL is from the different ESS sub-projects (in this case the Instrument Projects).

The overall instrument installation needs to be divided into a proper amount of "installation packages", with all the relevant documentation collected systematically in the corresponding "installation binders". This responsibility falls on the instrument IPL, and is crucial in obtaining the approval from the Installation Coordinator during the Installation Readiness Reviews (IRRs). The physical field access of the installation teams is eventually approved by the Area Coordinator and later on, a specific "work order" is submitted by the IPL, for those tasks that have already achieved a successful IRR. The amount of "installation packages" (and consequently installation binders) is also a topic that deserves a certain degree of attention. Definition of a suitable number of IRRs, needs to be done together with NSS, in order to avoid the temptation to collect the instrument installation in only a few packages, with the consequence of losing the necessary details able to ensure a safe and successful installation. More info can be found on the main Installation page https://confluence.esss.lu.se/pages/viewpage.action?pageId=330386470 and the NSS Binders page https://confluence.esss.lu.se/display/EWO/NSS+BINDERS
More details regarding the specific responsibilities belonging to the Central ESS Installation Organization as well as those in charge to the Instrument and NSS projects by the appointed IPLs are summarized below.

ESS Central Installation Organisation:

- *Own and control installation areas on site (BASU/AREAC)*
- *Own the installation process & the installation schedule*
- *Schedules and coordinate installations*
- *Enforces rules and regulations*
- *Gatekeeper for start of installations (IRR go/no go)*
- *Prioritize installation (field calls)*
- *Facilitate construction site on-boarding*
- *Facilitate setup and use framework services (sub-contractors)*
- *Manage the framework contracts (together with procurement)*
- *Provide installation services (own some, front all)*
- *Advise on installation method & on installation resources*
- *Coordinate all activities toward SEC*

IPLs are budgeted and formally appointed by the Instrument and NSS Projects (NSS in those installations directly managed internally, e.g. Bunker, Common shielding project and so on). IPLs are;

- *Responsible for driving a specific installation from start to finish*
- *Responsible for supporting in establishing the detailed schedule for the package*
- *Responsible for making sure an Installation Binder is prepared*
- *Responsible for arranging an IRR*
- *The main interface for in-kind or contractor for that specific installation*
- *Responsible for keeping track of the installation and report status*
- *Responsible to mitigate and solve issues before and during the installation*
- *Responsible for making sure NCR is submitted if needed*
- *Responsible for making sure documentation is in place before closing the package*

The installation binders, prepared step by step from the IPLs, will include all the necessary documentation to answer at the following questions:

- *What are we going to install/test?*
- *Who are going to do it?*
- *What are the steps involved?*
- *When are we planning to do it?*
- *How does the method we are going use look like?*
- *Do we have the drawings?*
- *How are we going to make sure we have accomplished the task?*
- *Are there any risks associated with what we plan to do?*
- *What help and services do we need to do it?*

All IPLs are coordinated by ESS installation organization as above described and contact names for a better understanding of the process are Antonio Bianchi and Dirk Offermans, respectively appointed as Installation Coordinator and Area Coordinator.

2. LESSONS LEARNT NSS INSTALLATIONS

Below, some of the NSS projects states their Lessons Learnt of completed installations. This is specific for these projects and might not be applicable on all future installations. In addition, NSS are doing other installations not covered here – for example the Bunker, Common Shielding and Electrical Infrastructure.

2A. NMX INSTALLATIONS – LESSONS LEARNT

The NMX Cave is a construction in regular concrete with 90 cm thick walls and roof, built by assembling large pre-casted elements on a cast-in-place thick foundation. The original ESS design was further developed and validated radiologically at the Centre for Energy Research in Budapest (IK partner). The detailed design and construction of the NMX cave has been procured by ESS with a supply contract signed in June' 19. The installation, originally planned to start in February (2020) and to end in April, started already in December'19 by treating the foundation casting as a stand-alone installation package with its own installation binder and reviews. The cave construction was completed in summer 2020, including the installation of the local crane. Part of the delay was due to Covid-19 affecting the production of concrete elements.

Figure 1 Crane operations at NMX Cave

Figure 2 Access and space needed changed during different phases

The installation was preceded by an extensive planning phase that included the coordination between NMX IPL (NMX Lead Engineer), construction and area coordinators and the different ESS partners. Such coordination is constant now during the installation phase to ensure the compatibility of the ongoing operations with the work in the hall and with the availability of the ESS support teams. Engagement with the rigging team during the design phase ensures the feasibility of the installation method and availability of personnel (with the support of the installation coordinator the overhead crane was modified to reach necessary coverage). Long term operations of the overhead crane have eventually been subcontracted to an ESS commercial partner through a framework agreement, and it is paid by the instrument. Communication with ESS Logistics works very well to ensure access to the site to delivery trucks and to provide unloading support.

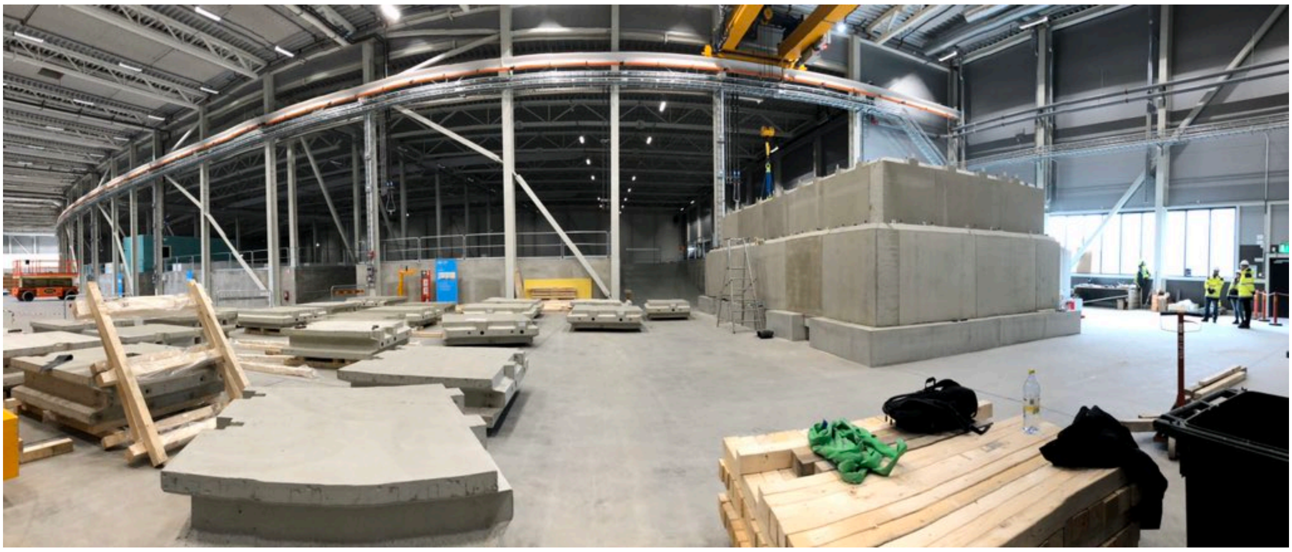

Figure 3 Logistic needs were agreed with area coordinators

Involving the Survey and Alignment team (SAM) from the design phase, provided support for geometry validation of walls, sample position marking and transfer of the laser tracker reference network into the cave before the line of sight was hindered by the presence of the walls. Communication with SAM was simplified by common use of Catia collaborative space. On the field, coordination was necessary to identify suitable new points for the future reference network marks.

Figure 4 Metrology operations verifying walls positions

The cave supplier subcontracted some of the services to suppliers available on site (Preparation of the E01 slab, construction of scaffolds, rental of Scissor lifts, supply of fresh concrete), which greatly simplified the IPL work and the construction coordination as these, already familiar with ESS/SEC procedures, were able to provide the necessary documentation (RAMS).

In conclusion, NMX benefitted from a relatively quiet hall and the exclusive availability of the overhead crane. After a steep learning curve to familiarize with the different procedures, the IPL work continued smoothly but with a steady workload oriented towards ensuring the timely availability of services to the team erecting the cave. The frequent presence of the IPL on site and the, almost daily, interaction with the area coordinators is instrumental to a smooth and safe execution of the work package.

Figure 5 Scaffolds being erected around cave walls

Figure 6. Painted NMX Cave

2B. BIFROST INSTALLATIONS – LESSONS LEARNT

The BIFROST Hutch will be used to house instrument scientists during operations and is situated within the E02 building (guide hall). Conventionally, this would be a relatively simple project but the lack of crane in the area and the desire to optimise the space available ensured we needed a custom solution. Therefore, we launched a tender looking for a structure built up on site and we received one bid from a Danish company. However, once we explained the rules for performing electrical installations on the ESS site (courses, inductions, certification to work in Sweden etc.) they didn't want to proceed with the bid. We then approached companies directly and contracted Skanska Direct (offshoot of Skanska) to manage the build. They are on-site already, had already executed projects on ESS' behalf and know many other sub-contractors available to perform work (electrical and painting).

Two installation readiness reviews (IRRs) were required. Initially, the necessary documentation from the contractor was slow to arrive and certain proposed building materials were rejected the week before planned installation due to the deemed fire risk (had initially been approved). The IRR was officially approved a day before work was due to commence.

Once work commenced, the BIFROST Engineer assumed the role of the IPL. A designated work area was created away from the final point of installation due to work being conducted on the beamline shielding simultaneously. The contractor was able to arrange all deliveries and interactions with the rigging team themselves whilst already having all the necessary inductions/access/PPE to perform the work on site.

Figure 7 – Build progress showing structure (left) and with additional insulation (right)

In order to check on progress and respond to technical queries, the IPL/BIFROST Lead Engineer visited the build site mostly once but sometimes twice a day. Each visit generally took a minimum of 30 minutes due to PPE changes and the distance across site. The build moved quickly (finished in 4 weeks) but despite the relative simplicity, not without incident. There were no injuries but two incidents/near misses were logged, three occasions of incomplete PPE were observed and an undocumented work procedure was performed. Our assessment of this is that the contractors relaxed in the relative safety of a quiet E02 building, but it forced the IPL to have a more visible presence on the build site. With all that said, we were pleased with the final product and our belief is that other than one small incident, the work was performed in a safe manner.

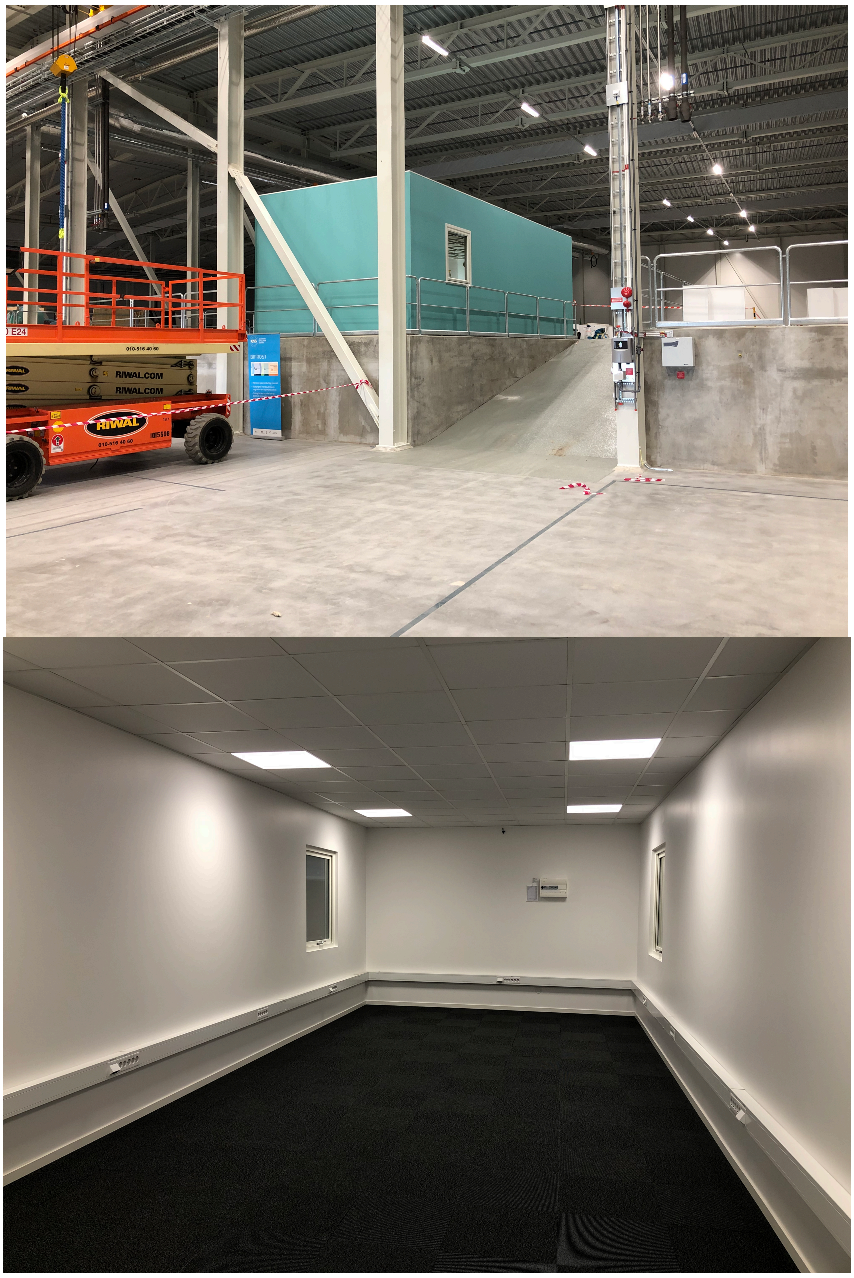

Figure 8 – Final product in position (top) and internally with all electrical circuits and lighting (bottom)

2C. E03/E04 laboratory installations – Lessons Learnt

The installation of the chemical and technical laboratory installations in E03 and E04 have been ongoing since January 2020. The installation includes setting up of furniture such as fume hoods, benches, overhead booms and similar, as well as needed utilities in the laboratories such as domestic water, DI water, cooling water, gases and electric. The chemistry laboratories are an in-kind contribution by STFC, UK, while the technical workshops are outfitted by ESS. For cost-saving reasons and practicalities, we have one UK contractor (Sanber Ltd) installing all chemical and technical labs in E03 and E04 at the same time.

Installation activities: At the last IKON we reported on several issues we had during the start-up of the installation and during the first few months such as delivery problems, suddenly new quality requirements, ESS vs. UK safety standards, differing work practices and similar. A lot of these got resolved and work has become a lot smoother. The SAD and ITD staff were (and still are) present in E04 while our contractors are working in E03 and E04 - each day 7 am to 6 pm and also every respective weekend. Due to our daily presence on-site, we were able to respond quickly to any issues, to answer arising technical questions immediately and so avoided many problems. This strategy prevented delays and lead to a much improved final product/fit-out. At the same time, our presence sent the message to our workers that safety and quality of work is of importance to us. By doing so, we believe we have established the necessary safety culture and have ensured that the quality of work is at a pleasingly high standard.

Figure 9: Physical Characterization lab 90% done (left). Electrical installation in technical laboratories (right – top: sample environment workshop, bottom: optics lab)

Providing this tight overview on the work performed at E03 and E04 we were also able to discover leaks twice encored from CF FM testing in the main hall. Due to timely intervention only marginal damage of materials has to be reported.

We are now completing the final 25% of the work in E03/E04. We had two interruptions due to the pandemic which lasted together almost four months. Due the engagement and commitment of our in-kind partner and our team the work is progressing well, and we expect to finalize the work by the end of 2020, which is still well within the original schedule. In 2021, we will continue with the fit-out in D08 (incl. RML) and D04 as they become available.

Current challenges: The issues we are facing are mainly related to quality assurance as a lot of the quality requirements for utilities that have been applied to us were inherited from accelerator and target construction projects or were inspired from nuclear industry, and are geared towards high radiation areas. Many of these requirements are restrainingly conservative for the low radiation potential in supervised areas, e.g.: The labs are not in a high-radiation zone, and water leaks are not automatically causing contamination; The house vacuum system only needs is a rough vacuum not a high vacuum like the accelerator. Additionally, the construction know-how of our contractor and subcontractors, who specialize in laboratory installations, was not accepted by ESS-QC. We were asked to prove that their professional certifications, valid in the UK, are sufficient to fulfil Swedish standard. While some of this is fairly easy to do (e.g. electrical certification, scissor lift license, …) others proved to be almost impossible (e.g. brazing certification, pressure testing certification…) due to the varying legislation in the different European countries. A good quality support engineer to assist with “translating” these qualifications would have helped a lot.

Due to these issues, we have spent a lot of time at the beginning of the year and up to now to justify reasonable requirements for laboratories and reasonable standards for certifications. We gathered the knowledge from other, similar installations in Europe, and, additionally, we invested time in understanding some of the European standards that exist on these installations. This was very time-consuming. Hopefully, our experience and the requirement documentation we are writing, once approved, will be useful for further laboratory installation as well as for other installations such as the instrument specific laboratories.

NSS has started to mitigate some of these quality issues by assuring that the projects have access to a mechanical quality engineer and an electrical quality engineer. We are starting to use these resources as we are now entering the commissioning/testing phase of the installation.

Commissioning activities: The commissioning phase is also a phase where the documentation of the installation has to meet the ESS requirements. As we were planning the project two years ago, the requirements for documentation for the electrical installation was not fully developed (or not fully communicated) yet. We are currently faced with the problem that our electrical installation, while it follows the usual standards, is not documented in a software called E-plan and this inhibits the start of commissioning. It seems that we do have most or all of the required input, but we do not have it in the required software format. Our group does not possess the knowledge to “translate” it into E-plan. ESS is supporting us by temporarily hiring a consultant who will perform this step for us. We hope to report on this at the following IKON and possibly, if everything works out, to show our experience. Another topic is the commissioning of the fume hoods. While we have defined our acceptance criteria, we are faced with the challenge that the HVAC engineers currently at ESS are coming from the nuclear sector and are looking at it from another view point, and proposing overly conservative requirements and design solutions.

Figure 10: Chemical fume hoods testing with Siemens (building control system) and Sanber (fume hood/ducting specialist)

All in all, it seems that the laboratories together with NMX and BIFROST can illustrate well the open issues in the NSS construction project as we are the first ones installing. We hope that our experience will smoothen the path of the installations that come after us.