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MANAGING PROCUREMENTS IN THE TIME OF COVID-19: SNS-PPU AS A CASE STUDY*

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Abstract

In early 2020, COVID-19 swept across the world. The accelerator industry, like many others, was impacted by disease, delays, shortages, and new working conditions. All Thomas Jefferson National Accelerator Facility (JLab) employees were sent home in mid-March 2020, with many still working remotely now. At the time, JLab was working on the Proton Power Upgrade (PPU) to the Spallation Neutron Source (SNS) at Oak Ridge National Laboratory (ORNL). Procurements had been placed and were being managed, parts were being received and inspected. This paper details the JLab procurement plan for the SNS PPU project, and the mitigations that were developed to continue to support this project smoothly under the limitations imposed by COVID-19.

BACKGROUND

The Proton Power Upgrade will increase the beam power of the SNS proton accelerator at Oak Ridge National Laboratory from 1.4 to 2.8 MW and increase beam energy by 30%. During the original design of SNS, space in the linac was reserved for additional cryomodules to be added at a future time. As part of the PPU upgrade, eight cryomodules, each containing four high-beta superconducting cavities, will be added to the existing linac [1, 2, 3]. (Seven of these cryomodules were part of the original project scope, with the last added in 2021.)

JLab began work on the Spallation Neutron Source Proton Power Upgrade SNS PPU for ORNL in fall of 2018, with a scope of designing, procuring, and constructing the cryomodules for the upgraded accelerator (Fig. 1). The cryomodule was based on the original JLab SNS design from the early 2000's, and incorporated modifications made by SNS over the ensuing years. JLab revisited the design of each component with an eye to updating the design to reflect the latest standards in accelerator technology. The first year or so of the project was spent in cryomodule design, and procurement activities began around a year later, in summer/fall 2019.

JLab is responsible for procuring all components to support construction of the cryomodules, except for the cavities and fundamental power couplers. These are provided by SNS but still received, inspected and installed at JLab. Major procurements managed by JLab include the vacuum vessels, space frames, magnetic shielding, beamline bellows, helium vessels, tuners, instrumentation, and end cans, for a total of over thirty separate components. The procurement activities for these major components, as well as for a number of smaller items and hardware, were well underway by early 2020, as was the spread of COVID-19.

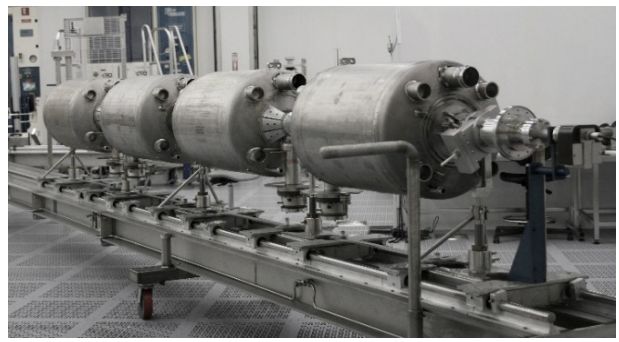

Figure 1: SNS PPU cavity string.

COVID-19 IMPACT

On March 17, 2020, JLab entered "MEDCON-6" status due to concerns about the increasing spread of COVID-19, and all but a few critical JLab employees were sent home. MEDCON-6 status requires that the lab close most facilities and limit staff on site to no more than 30 people in an attempt to interdict the spread of contagion. Employees who were able to work remotely, including scientists, engineers, and procurement staff, continued to do so. All inspection, testing and assembly activities ceased and were not able to resume, even partially, until mid-June, 2020, with JLab's reclassification to MEDCON-5 status (Fig. 2). This still restricted many operations but allowed a subset of staff to return to work on site to perform hands-on activities.

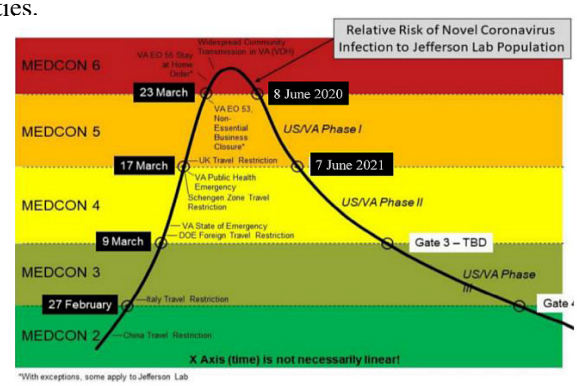

Figure 2: JLab's COVID-19 operations plan.

At the time of the JLab MEDCON-6 shutdown, about 85% of the approximately $9 million of procurements had been awarded, with over $1 million of that scheduled to be delivered to JLab within 3 months, and almost $3 million within 6 months.

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Due to the unprecedented circumstances, the project managers engaged with the JLab Strategic Acquisitions Group and laboratory leadership to develop a strategy to continue project activities to the extent possible, protect the lab from risk, and, where possible, support our vendors who were being impacted by COVID-19.

STRATEGY

During the MEDCON-6 status at JLab, staffing was limited to a few essential personnel, and social distancing and PPE were required for any on-site operations. This meant, inter alia, that no forklift was available to receive larger items such as vacuum vessels, space frames, cavities, and helium vessels; few SRF inventory staff were available to store parts or enter items into the inventory database for tracking; and no QC technicians were available for inspections. The limited staff on site could accept delivery of smaller packages which required no special handling. Overall, the lab was directed to minimize any non-critical activities on site.

JLab therefore had to devise a compromise between contractual obligations and JLab's capabilities under the restricted operations of MEDCON-6. In addition to the considerations above, the plan had to balance factors such as JLab's financial exposure in either paying for parts not received or receiving parts that could not be inspected, the lab's legal obligations to its vendors, and a desire to support vendors who were themselves being impacted by COVID-19. Discussion between the Strategic Acquisitions Group of the procurement department, the legal department, lab leadership and project management attempted to reconcile these factors.

After consideration of various options, it was decided that the optimal strategy was a two-pronged approach, with one path for smaller/non-critical items and a second path for large, critical items (Fig. 3).

Month	Total Open Amount	Simple Items	Complex Items
April	$547,105	$442,470	$104,634
May	$539,017	$152,443	$386,574
June	$302,411	$64,455	$237,956
July	$610,776	$264,880	$345,896
August	$312,314	$0	$312,314
September	$444,364	$236,790	$207,574
Totals	$2,755,987	$1,161,038	$1,594,949

Figure 3: Separation of procurements by complexity.

Procurements were categorized as either simple items (generally small, off-the-shelf or routine parts requiring minimal inspections) or complex (parts requiring extensive inspection, careful handing, or which could not be unloaded and moved by one employee working alone). The division of parts between simple and complex was a fairly even split, based on value.

As all procurement officers and technical representatives continued to support PPU activities from home, active discussions continued with vendors about their production statuses and about handling deliveries during JLab's restricted operational environment

IMPLEMENTATION

Vendors were made aware of the limitations of JLab's operations. In some cases, the vendors had COVID impacts of their own which delayed production. One vendor had redirected all their operations to making parts for ventilators, which resulted in a delivery delay of several months. Others were hampered by outbreaks of COVID at their facilities, or by delays due to restructuring and limiting their on-site operations.

One significant concern was the warranty period for parts. Typically, the subcontracts/purchase orders provide for a one-year warranty period in case of any defects in parts, to begin when parts arrive at JLab. In this case, there was concern that since technicians were not available to inspect parts, parts would sit until JLab staff returned to work, by which time there would be a large backlog of parts needing inspection. This could have pushed the inspection of parts that were not prioritized as being critically needed out past the warranty period. Warranty extension was thus a focus of negotiations with vendors. (It is worth noting that due to experiences on recent large projects such as LCLS-II, even under normal operations, it was a challenge inspecting and installing some components before the warranty periods expired. Therefore, the JLab Strategic Acquisitions Group has more recently started asking vendors for 18-month warranties.)

It was a priority for JLab to find a reasonable compromise for these unusual times which would not financially disadvantage either our vendors or the lab. The lab therefore proposed to vendors to pay them in full for completed parts if they agreed to extend the warranty such that it would not begin until lab staff were back on site and able to begin inspections (the date of which was unknown at that time). The lab had decided to hold back a portion of the fee to protect the lab in case any vendor would not extend the warranty, but, in the end, all vendors agreed to warranty extensions.

During MEDCON-6, the JLab shipping and receiving department was staffed on Fridays only. The guards on site could receive smaller Fed Ex or UPS packages any day, but these would not be opened to have the contents verified or be entered into the inventory database as received until Fridays. Vendors of smaller items were made aware of the possible delays in processing and allowed to ship.

Larger items requiring a forklift or pallet jack to unload could be received on Fridays. These would be unloaded and delivered to the Test Lab building. Separately, to ensure social distancing, a member of the SRF inventory staff would receive and store the items.

Large items which could not be handled by one employee with a forklift had to be stored at the vendor until the lab staff were allowed back on site and able to work within 6 feet of each other. In one case, however, this issue was averted when a vendor was able to design new crates and repackage their shipment so that it could be unloaded by one person.

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JLAB RESUMPTION OF OPERATIONS

In June 2020, JLab moved from MEDCON-6 status to MEDCON-5 status. This allowed essential staff (about 25% of the total workforce) to return to work, while other workers continued working remotely. Production activities resumed, with some accommodations for COVID protocols.

All staff were required to wear masks at all times, or full-body personal protective equipment (PPE) and respirators if they had to work within six feet of each other (Fig. 4). As the PPE industry was also affected by COVID-19 and PPE was difficult to obtain, procedures were revised where possible to maintain a six-foot distance between personnel. (In addition, the full-body PPE was hot and uncomfortable to work in for long periods of time.)

Inspection of PPU components could therefore resume, which also triggered the start of the warranty period. Staff worked diligently to inspect the backlog of parts that had arrived.

Figure 4: Production operation requiring PPE.

INSPECTION

Typically, the inspection process at JLab begins with an inspection traveler written by the JLab technical representative responsible for a given component, using the proprietary Pansophy data management system. Separate inspection travelers are written for different work stations, such as visual inspection, dimensional/CMM inspection, leak check, pressure test, and cold shock. Skilled technicians at JLab carry out the inspections and enter the resulting data into the travelers. Non-conformance reports are generated where appropriate, and the technical representatives disposition them, based on whether the parts should be accepted or reworked or rejected.

During MEDCON-6, when most technicians were sent home, inspection activities ceased except on mission-critical jobs. Because the engineering and IT staff were continuing to work from home, however, development of inspection travelers continued unimpeded.

Subcontracting Inspections and Other Work

In some cases, JLab contracted with the vendors to perform inspections. For example, the heat exchangers and bellows for the end cans were JLab-supplied equipment which had been procured separately by JLab and were intended to be received and inspected at JLab before sending them to the end can manufacturer. The end can vendor had a vested interest in keeping their workforce productive, and was willing to take on the additional work of the inspections to maintain their schedule. The JLab technical representative wrote detailed inspection travelers for the heat exchangers and bellows, and had the parts shipped directly to the end can manufacturer, with JLab to later receive fully assembled end cans (Fig. 5).

Figure 5: Heat exchanger assembled at vendor.

Subcontracting to vendors extended to assembly activities also. The space frame and thermal shield were awarded to two vendors (coincidentally located near each other), and a decision was made to modify the contract of the space frame vendor to include inspection of the thermal shield per JLab specifications, as well as assembly of the two items together (Fig. 6).

Figure 6: Space frame/thermal shield assembly.

This allowed production activities at the vendors, both of whom continued to work through the pandemic, to continue; it gave JLab a basis for approving payment to the thermal shield vendor by validating the product; it helped to reduce the workload that would be awaiting the JLab inspection and assembly staff upon their return to work; and

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it maintained the project schedule at JLab. The JLab technical representative wrote and sent the vendor an inspection traveler for the thermal shields, and followed inspection and assembly activities remotely.

There was also concern that the possibility of discovering discrepancies in parts after JLab staff returned to work would hinder attempts to make up lost time in the production schedule. Therefore, in some cases, vendors were contracted to perform additional inspections which would normally have been performed at JLab in order to reduce the risk of failed parts. The helium vessel contract, for example, was modified to add a leak check performed by the vendor to detect any issues.

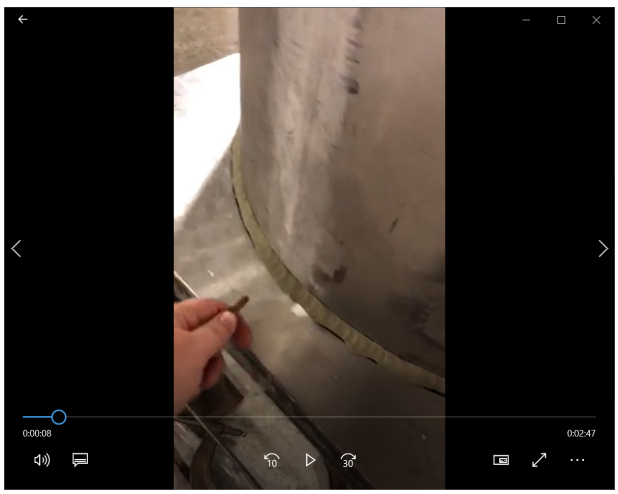

Figure 7: Recorded video of leak check.

Remote Inspection

As travel and visits to vendors were (and still are) prohibited, the project developed new ways of monitoring vendor production and witnessing inspections and tests.

It should be stressed that in the past we have found in-person vendor visits invaluable in identifying and resolving issues. In-person visits tend to be productive for discovering incipient issues that have not yet become critical enough for the vendor to disclose them. They are useful for permitting JLab staff to verify the manufacturing process as well as for in-process inspections. And, less technically, they allow JLab and vendor staff to become acquainted in a way that will facilitate future communications and overcome barriers imposed by differences in language or technical background. Vendor visits have generally been found to produce improved production methods, speedier problem resolution, and cost savings. In fact, the project had planned, in pre-COVID times, for frequent visits to status and monitor production at vendors.

JLab's approach has typically been to hold a kick-off meeting, usually in person, with vendors before the beginning of production, and before any significant changes or additions to the production in order to review requirements and ensure agreement on important issues. Should any significant technical issues arise during production, in-person visits were also the preferred method of resolution.

By the spring of 2020, most procurements had been awarded, and most kick-off meetings had been conducted in person. But after the implementation of MEDCON-6, trips to vendors were abruptly cancelled, so staff looked for alternate ways of monitoring progress.

Frequent, regular phone calls or video conferences with vendors were scheduled instead. (It should be noted that not all vendors were familiar with video conferencing; there was a learning curve on all sides, and creative technological solutions. In one case, a vendor resorted to having one of their technicians use his iPhone to show JLab staff a test over Facetime.) Vendors were required to provide regular photos showing progress. Inspections and tests which would previously have been witnessed in person by JLab staff were instead witnessed over live video conference (allowing interaction between JLab technical staff and the vendor) or recorded videos (for documentation or sharing with other staff). This turned out to be generally successful. (See Fig. 7 for recorded videos of leak checks, Figs. 8 and 9 for cold shocks conducted live over video conference, and Fig. 10 for a live and interactive visual inspection, with real-time guidance from the JLab technical representative.)

Figure 8: Remotely-witnessed cold shock.

It should be noted that remote monitoring of vendor activity was not without issues. Some tests and inspection processes had to be repeated when the photos and videos weren't clear enough for JLab staff to verify the work was done correctly. And, certainly, communication with vendors via phone or email was more cumbersome and ambiguous than in-person discussions.

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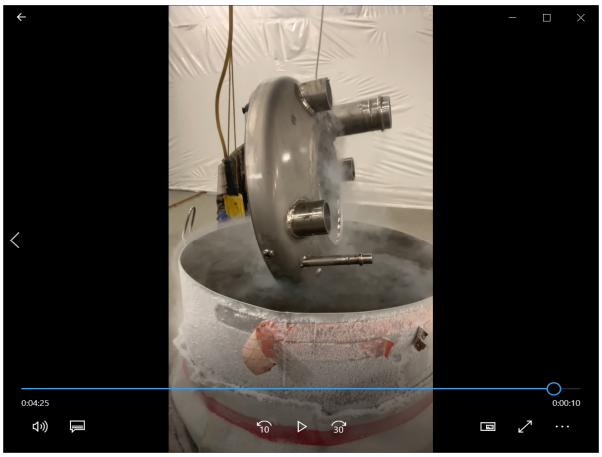

Figure 9: Remotely-witnessed cold shock.

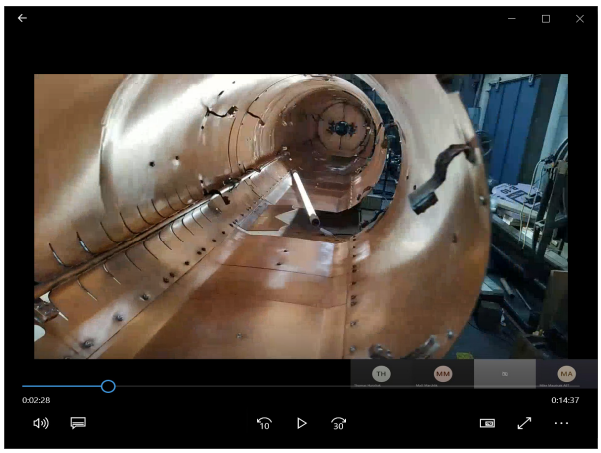

Figure 10: Live visual inspection.

Shipping Approval

In addition, to reduce risk during shipping, vendors were required to provide photos of finished parts and packaging for approval prior to shipping (Fig. 11). This served both to reduce the risk of damage to parts during shipping which might not be identified for some time, and also to ensure that packaging was suitable for being unloaded in accordance with JLab's MEDCON-6 restrictions. In at least one case, parts had to be repackaged so they could be unloaded by one employee working alone.

On previous projects, unexpected damage to components has occurred during shipping. Because PPU was already absorbing unplanned delays due to COVID-19, extra care was taken to verify that parts were securely packaged for transport to ensure safe arrival at JLab and mitigate the risk of additional unplanned delays.

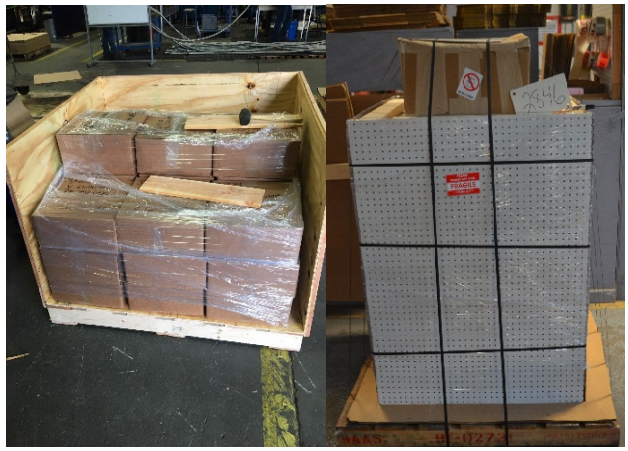

Figure 11: Examples of pre-shipping confirmation photo.

CONCLUSION

The past year has been unprecedented, and has required creativity and adaptivity to keep the SNS PPU project at JLab on track. The project faced three months of limited operations at JLab and over a year of mitigations imposed on staff, such as remote work and inability to travel. There were delays due to COVID-19 at multiple vendors. Nevertheless, by developing and deploying new methods of managing procurements, JLab was able to minimize the impact of COVID-19 on PPU.

Today, the project has successfully completed the first string assembly with good performance indices for both cost and schedule, and is on track to deliver all cryomodules to PPU in time to support their upgraded accelerator.

ACKNOWLEDGMENTS

Many thanks to the JLab staff, too many to name, who worked diligently despite COVID-19 to ensure a successful project.

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