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<b>14. ABSTRACT</b> This project was to reactivate the equipment in Building 4909-5, Shear Roll Mill Pilot Plant at Radford Army Ammunition Plant. The pilot plant has been restored to a condition that will accommodate a trial run of inert single base pellet feed for use in a twin screw extruder.					
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# **Final Report**

**For**

## **Shear Roll Mill Reactivation**

**Initiative No.: OTA5 2010-33 INIT-248**

**Reporting Period: January 2011-May 2012**

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## **1.0 Summary**

This project sought to reactivate the equipment installed in Bldg. 4909-5 – Shear Roll Mill Pilot Plant at the Radford Army Ammunition Plant (RFAAP) in order to produce pellet feed for a twin screw extruder used to make solventless propellant. The process equipment was to be repaired and reconditioned to make it operational. After prove out on inert propellant, the equipment was then to be used to manufacture energetic material. The building is now in a condition where it is capable of producing inert propellant to simulate feed for a twin screw extruder. Preventive maintenance procedures were in progress in final preparation for running with inert material, when the project was cancelled.

## **2.0 Introduction**

The process equipment in Bldg. 4909-5 at the Radford Army Ammunition Plant was originally intended to model a process designed to minimize the cost of producing solventless propellant. The equipment was designed to produce either a pelletized form of feed for a twin screw extruder, or sheet material for production of carpet rolls to be processed by a horizontal hydraulic press. This particular facility has been inactive since approximately 2004. Due to renewed interest in the process involved, this project was intended to reactivate the facility and produce solventless inert pellet feed for use in a twin screw extruder. If proven successful, the building would then have been used to produce energetic material for the actual production of solventless propellant

## **3.0 Methods, assumptions and Procedures**

The approach to reactivating Bldg. 4909-5 involved four major items:

- Verifying that the utilities serving the building were operational and in good repair. This included the compressed air provided by a 25 hp reciprocating compressor, building filtered water supply, both the building and process equipment sprinkler protection systems, and the 5 psig steam supply serving the building heating and make-up air systems. It also included the 440 v. electrical system providing power for process equipment motors, shear roll hydraulic pump motors, the air compressor motor, as well as lighting and control circuits.
- Test running the process equipment to be sure it would still function as originally designed. This involved the pneumatically operated paste dumper and belt conveyor system, the loss in weight feeder system, the hydraulically operated shear roll mill, the pellet out feed belt conveyor, and the pack out system comprised of the metal detector, scale, and pack out empty and full drum roller conveyors.

- Verifying the operability of the PLC control system, with its interface to a PC in the building control room. The PC is furnished with SCADA (Supervisory Control and Data Acquisition) software manufactured by Wonderware.
- Making required building repairs, including the Griffolyn explosion vent panels in the South wall, as well as the escape doors on the South side of the building. The Griffolyn had torn in a number of places, and several of the escape doors were in extremely deteriorated condition.

Upon restoring the process equipment to running condition, the building was to be run first with inert material. If successful, it would then have been run with energetic material.

#### **4.0 Results and Discussion**

Examination of the PLC cabinet revealed that a new communications module was required; a new one was purchased and installed. It was later verified that the PLC system worked in conjunction with the PC in the control room to send control signals as required by the process.

When the filtered water supply valve was turned on to the building, it was discovered that a 3- inch tee at the valve pit on the Northwest corner of the building had frozen and cracked. In addition, there was also a break in the horizontal overhead line running over to the utility building, which is fed from this tee. This line had been heat traced with a small steam line to prevent freezing, but the steam had been turned off at the pressure reducing station supplying the building. The broken tee and line were replaced.

A freeze damaged radiator in Bay 5 was removed and replaced with a radiator from Bay 4. This radiator was not plumbed into the steam distribution system. The make-up air unit heater in Bay 4 was observed to have a damaged steam coil. This coil was removed and replaced with a new one.

The steam pressure gauges at the pressure reducing station were found to be “pegged” and therefore dysfunctional. These gauges were replaced. The steam tracing lines used to freeze protect the filtered water line supplying the utility building was found leaking, and was repaired. A new isolation valve was installed on the 275 psig branch line feeding the pressure reducing station; neither the existing stop valve at the pressure reducing station, nor the branch line valve at the 275 psig main appeared to be holding 100% . The steam trap on the 275 psig feed drip station was observed to be blowing through, and was replaced. It was observed that this condition was particularly problematic, due to the fact that the 275 psig drip station line was teed into the 5 psig drip station line, with the discharge of the manifold having been plugged due to being buried in the ground. In order to insure separation of the 275 psig and 5 psig steam supply lines, the drip station lines were physically separated, instead of being tied to the same manifold. The French drain at the steam station was reworked, and separation of the two condensate lines was insured by means of an air gap, discharging into the French drain.

At the recommendation of the local Spirax-Sarco manufacturer's representative, the pressure regulating valves and safety valves were replaced at the pressure reducing station. A weather cover was added to cover the steam station, in order to help prevent deterioration of the new valves.

During preliminary running of the air compressor, it was observed that there was absolutely no condensate drainage from the condensate trap on the compressor after cooler. When an inspection was later performed by a Hartford Steam Boiler representative, it was discovered that the air receiver was half full of water. Upon further scrutiny, it was obvious that the compressed air was piped to the air receiver, and then through the after cooler. Normally, when an after cooler is used, the air is piped through the after cooler first, and then through the air receiver. This condition has resulted in an abnormal amount of water in the compressed air lines serving the process equipment.

It was observed that occasionally the Penn pressure switch in the disconnect enclosure next to the compressor had to be manually reset in order to allow the compressor to come on to rebuild pressure after the initial charge of air in the air receiver had been depleted.

The Primac system was found to have several relays missing, as well as a selector switch used to bypass the fire alarm panel. New relays and a new switch were installed. However, it was determined that the interlock with the Primac system requires rewiring, in order that the process equipment control system can be run for maintenance and/or checkout while the fire alarm panel is bypassed.

A sprinkler line and gate valve serving the Primac system were found to have been freeze damaged in Bay 5. This line and valve were replaced.

The present building configuration employs the 25 hp air compressor in the utility building to supply air pressure for the building deluge sprinkler protection. Due to the less than dependable performance from the existing compressor control system, a hydraulic air pump was installed in the building to supply the air pressure for the deluge system. This is the standard piece of equipment used to serve this function, and should prove much more reliable than the present means.

The paste feed hopper and conveyor supplying the loss in weight feeder were turned on, and it was verified that these items functioned as designed.

The metering system supplying feed to the shear roll mill rolls was operated from the control room PC, and appeared to function correctly.

Both the "empty tub" and the "filled tub" out feed conveyors ran correctly using calibration weights obtained from the Metrology Laboratory on-plant, although more slowly, probably due to needed lubrication. The PLC timer settings on these conveyors were increased, in

order to allow the linear actuators sufficient time to move the empty and filled tubs into position on the conveyors.

The conveyor motor windings on the empty tub conveyor were wet, and had to be dried out by running the motor under no load for a number of minutes. The filled tub conveyor was found to have a bad control circuit transformer; the transformer was replaced, and the conveyor motor operated as designed.

The filtered water pressure regulating valve and filter were both found to be leaking. Both the pressure regulator and filter were replaced. Three of the four check valves that had been plumbed into the supply lines feeding filtered water to the roll tempering units were observed to be leaking. They were found to have cracks in them, and were subsequently removed from the system. When operating the tempered water units from the control room PC, it was seen that the water temperatures were not being controlled as evenly as expected. The pressure regulating valves were found to have collected pipe scale, and the solenoid cooling valves were filled with mud on several of the units. After cleaning these components, all four water tempering units supplying tempered water to the two shear mill rolls were observed to function correctly, as indicated by the display on the control room PC.

One of the valves in the filtered water lines running underneath the shear roll mill in Bay 3 was observed to have frozen, and was replaced.

The flow divider valve serving the two cylinders which push the rolls together was observed to have two broken bolts and damaged O-rings. Upon replacing the bolts and O-rings, it was determined that the flow divider valve now works correctly, and the rolls come together as designed.

A gauge set was obtained in order to check the charge on the hydraulic accumulator on the pump supplying the cylinders which push rolls together. The accumulator was found to still have an adequate charge of nitrogen in the bladder.

The shear roll mill rolls were turned on, but one of them failed to operate. The hydraulic pump serving this roll was examined per manufacturer's instructions. As a result of the recommendation by the manufacturer's representative, the pump was sent in to their repair facility for service. After return and reinstallation of the hydraulic pump, the roll was observed to function correctly.

One of the temperature controllers which controls a tempering water loop for the shear roll mill was observed to be indicating incorrect data. This unit was sent in to the manufacturer for analysis, but it was found to be cost ineffective to repair. A new controller was installed in its place, and programmed similarly to the other controllers. It was subsequently verified that the temperature of the water pumped through the shear mill roll was modulated to maintain the set point temperature as required. This was observed on the control room PC screen.

An existing 4-20 ma transmitter indicating hydraulic pressure from one of the shear roll mill hydraulic pumps was found to be so corroded as to be totally dysfunctional. A new unit was ordered to replace it.

The Griffolyn panels which were observed to be torn were replaced on the South wall of the building. Several dilapidated escape doors on the South side of building were removed, and replaced with newly fabricated doors. Door “latches” were installed on the North side doors, similar to those currently installed on the South side escape doors. This addition expedited access to the North side entrances of the process bays.

## **5.0 Conclusions**

Building 4909-5 – Shear Roll Mill Pilot Plant at the Radford Army Ammunition Plant (RFAAP), has been restored to a condition which will accommodate a trial run of inert single base pellet feed for use in a twin screw extruder.

## **6.0 Recommendations**

At the present time, the steam radiators used to heat the building are either on all the time, or off all the time. The building temperature can therefore vary, depending upon the outdoor temperature; this situation will result in excessive and unnecessary energy consumption. If the building is used in the future, it is recommended that thermostatic radiator valves be used. These valves could be installed in the supply lines to the individual radiators, to insure that only that amount of heat required by the process, or for freeze protection when not operational, is supplied to the building.

An extensive amount of electrical corrosion was observed inside the utility building. It is suggested that the gravel fill surrounding the utility building be reworked, so that as a minimum, the level of gravel is below the level of the slab for the utility building. In this manner, there will be a minimum of water conducted into the building, and consequently a reduced degree of corrosion experienced by electrical wiring and components.

Prior to startup of the building, all established preventive maintenance procedures should be conducted. These include not only electrical and control equipment checks, but also lubrication and hardware inspections, as well as control interlock checks.

Future use of this facility also demands attention to the compressed air system for the process equipment. A 25 hp reciprocating air compressor in the utility building now furnishes this compressed air. At the present time, this compressor is piped such that the compressed air first passes through the air receiver, and then proceeds to the after cooler. Convention would dictate that the air is routed first through the after cooler, and then to the air receiver. This situation would explain why the air receiver was observed to be half full of water during a recent inspection by the Hartford Steam Boiler inspector. As a minimum, the building operating procedure should contain a provision that the blow down valve on the air receiver



be opened at the start of every run, or a condensate drain trap should be installed on the air receiver. This latter recommendation may not be feasible, due to the limited headroom of the air receiver above grade in the utility building.