MOBILE SOLIDIFICATION SYSTEM INTERFACE

DESIGN CONSIDERATIONS

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ABSTRACT

This paper discusses design consideration for mobile solidification system interfaces at the Clinton Power Station. A description of the mobile interface design is presented. The details regarding the pipe routing, valve selection, and flushing provisions are included. The mobile solidification station, which centralizes all the interface requirements, is described. The control logic and new control panel are also discussed.

INTRODUCTION

A radwaste modification to enable mobile solidification services to process liquid radioactive wastes is being implemented at Illinois Power Company's Clinton Power Station. This modification is being made to ensure that radioactive wastes can be solidified to provide a product that is in compliance with 10 CFR 61. The existing in-plant solidification system was designed, fabricated, and installed before 10 CFR 61 became effective. The modification also provides processing flexibility and a means to adapt to changing regulations and technological developments. This paper will discuss the considerations that were involved in the design of this modification.

EXISTING SOLID RADWASTE SYSTEM

The existing Clinton solid radwaste system consists of several waste collection tanks, their associated pumps, piping, and valves, and the in-plant solidification system. Collection tanks are provided for spent bead resin, fuel pool filter demineralizer sludges, reactor water cleanup (RWCU) sludges, filter sludges, and evaporator concentrates. Two tanks are provided for each of these waste streams except spent bead resin, for which there is only one tank.

All the collection tanks, except the tank for evaporator concentrates, are located in the basement of the radwaste building. The evaporator concentrates tanks are located on the second floor of the radwaste building. The in-plant radwaste solidification system is located on the first floor mezzanine of the radwaste building.

MODIFICATION DESIGN CRITERIA

Several general design criteria were established for this modification. They included the requirement that the design modification should interface with the existing radwaste system in a way that would allow future modifications to be performed on the in-plant solidification system without excessive radiation exposure. This criterion required that the waste transfer lines to the mobile solidification station tap into the existing solid radwaste system upstream of the in-plant solidification equipment. With this feature present, any future modifications or maintenance on the in-plant solidification system can be accomplished in low-radiation fields, while waste processing can be performed by mobile solidification services.

A second general design requirement was that any changes to the existing radwaste system needed because of the modification were to be minimized. This required that the control logic for transferring waste to the in-plant solidification system remain essentially intact.

A third general design requirement was to examine the additional interface requirements for mobile volume reduction (VR) services. Wherever the additional interface requirements for VR were minimal, the provisions to support mobile VR were to be implemented.

ROUTING OF TRANSFER PIPING TO THE TRUCK BAY

The various waste streams to be processed include concentrates, spent bead resins, and sludges. As previously mentioned, the majority of these wastes are collected in tanks located in the basement of the radwaste building. (The concentrated waste tanks, however, are located on the second floor.) Most of the existing slurry transfer piping from the collection tanks is routed through pipe chases up to the second floor of the radwaste building and enters the in-plant solidification system from above (Fig. 1). Only the spent bead resin transfer line enters the in-plant solidification system from below. The existing pipe chase on the second floor passes through an empty room that was provided for future VR equipment.

The mobile solidification station, which centralizes all the required interfaces, will be located next to the truck bay on the first floor of

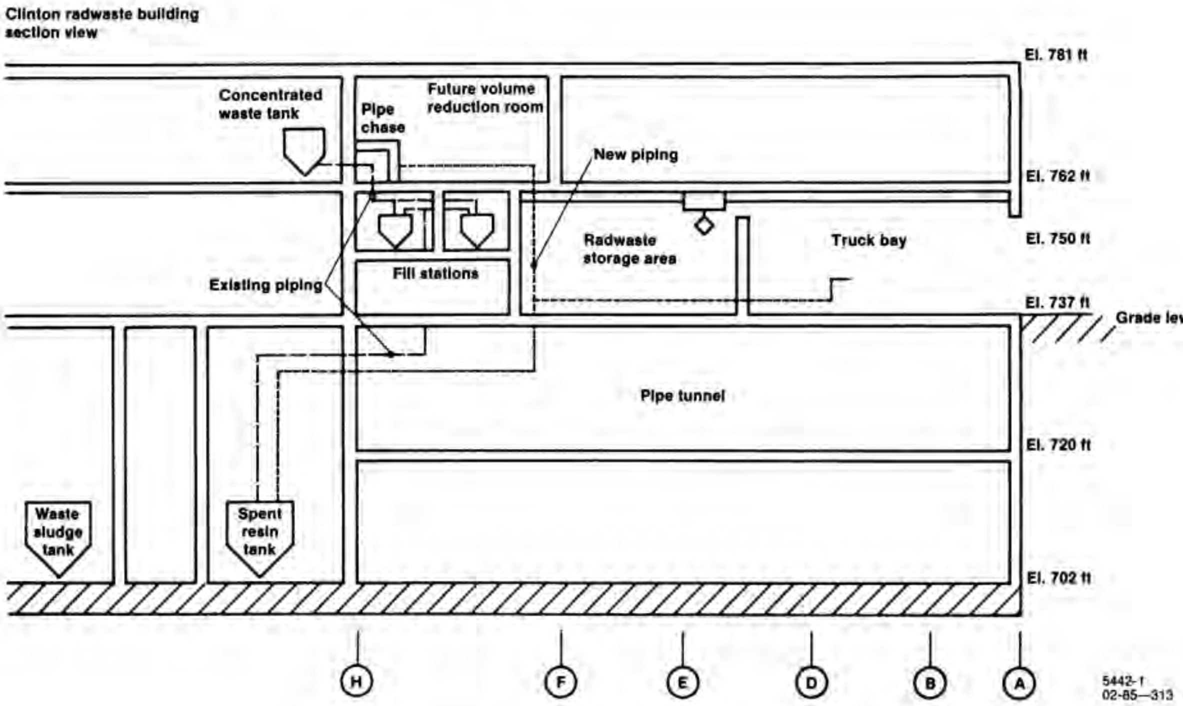


Fig. 1. Radwaste building section view.

the radwaste building. Space adjacent to the truck bay was provided for a future radwaste storage area to be provided in addition to the installed storage area (Fig. 2).

In order to minimize the amount of new shielding, the transfer piping was routed across the empty VR room, down through the floor into the radwaste storage area, and out to the truck bay (Fig. 1). The spent resin transfer line was routed into the storage area from below. This routing requires new shielding only in the future VR room and in the truck bay area. Because the piping was routed through the ceiling and floor of the storage area, the travel of the bridge crane had to be decreased. This resulted in a reduction in the storage capacity by about 100 drums (approximately 10%).

To incorporate this routing, a new valve aisle and pipe tunnel are required in the future VR room. The new valve aisle will contain divert valves, which will enable waste to be sent either to the in-plant solidification system or to the mobile solidification station.

PIPING DESIGN

Three important criteria to be considered for the waste transfer lines are flushing capability, waste segregation, and redundancy. Flushing after each waste transfer is an important feature in preventing the feed lines from becoming plugged. The majority of the flush liquid should be returned to a waste collection tank and not sent to the solidification equipment. Flush water sent to mobile solidification dilutes the concentration of the waste to be disposed of, thereby creating a greater volume of waste to be processed.

The waste streams should be segregated for several reasons. First, it is important to keep resin out of the evaporator feed tanks to protect the integrity of the evaporator. Thus, flush liquid should be routed back to the tank from which the waste originated. Second, any concentrated waste feed line will require heat tracing and Type 316 stainless steel piping. Resin and sludge transfer piping will not require heat tracing, and Type 304 stainless steel will be sufficient. Third, the minimum slurry velocity for each waste stream will determine the line size requirements. Since separate metering pumps are provided for each waste stream, the line size requirements vary from 60 to 48 millimeters (2 to 1-1/2 inches). Finally, since process control programs are required for solidification processes, segregation of the waste streams will prevent the inadvertent mixing of streams.

Redundant feed lines are also an important feature. If mobile solidification is the only processing option for some time, the delivery of waste to the system is critical. Flushing procedures and smooth bends should prevent line plugs, but redundant lines will ensure waste feed.

For the Clinton modification, two redundant transfer lines for concentrated wastes are routed to the mobile solidification station. These heat-traced lines are routed through the existing drum aisle, which is adjacent to the storage area for ease of maintenance (Fig. 2). In order to reduce piping costs, two redundant sludge header transfer lines are provided to the mobile solidification station. Each header will serve as the transfer line for filter sludge, RWCU sludge, and fuel pool filter demineralizer sludge. One spent bead resin transfer line is provided to the mobile solidification station. All five of these transfer lines are provided with isolation valves and end in flat flanges that will interface with vendor-supplied transfer hoses.

Recirculation lines were provided for the two sludge transfer headers and the spent resin transfer line. Recirculation of waste through the mobile solidification station was required to ensure

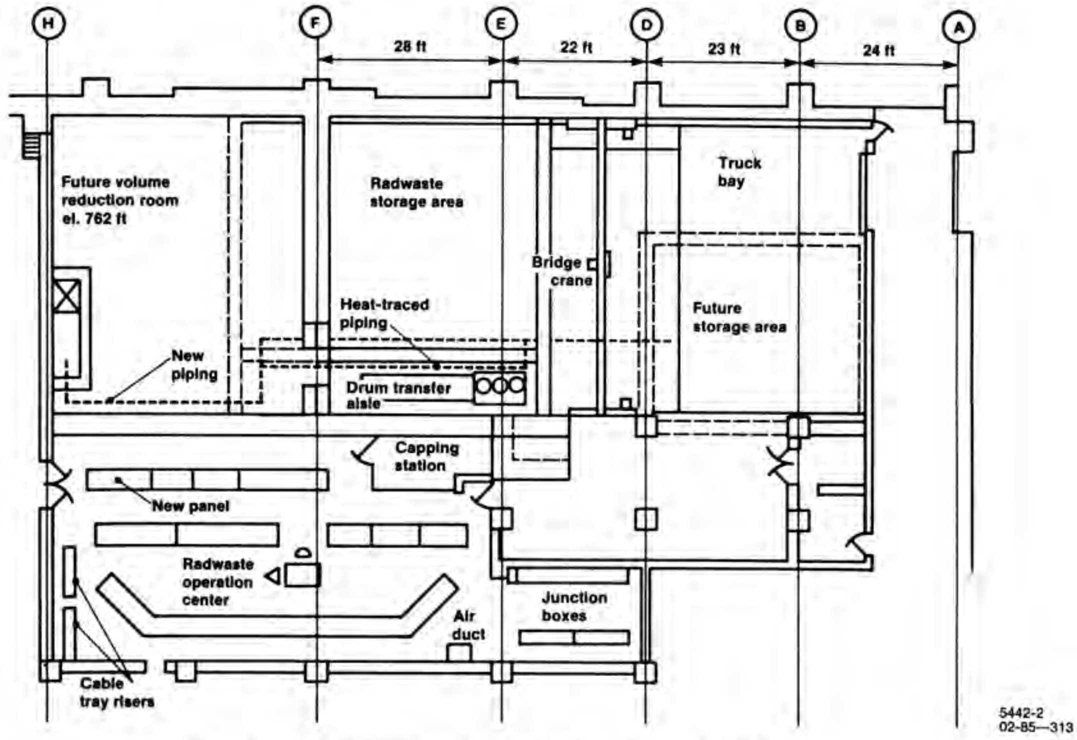


Fig. 2. Radwaste building plan view - el. 737 ft.

optimum packaging efficiency for cement solidification services. Many mobile cement solidification services will decant supernate liquid from slurries prior to solidification. A disposable cask liner is filled to maximum solids capacity by an iterative slurry fill and decant process. By minimizing the forward flush volume for long transfer lines, the actual solids capacity of the disposal liner is maximized.

The vendor's interfacing waste feed hoses require forward flushing. The minimum forward-flush water volume achievable, then, is that volume necessary to clean the vendor hoses. A recirculation line enables the entire volume of flush water for the in-plant transfer lines to be returned to the plant rather than being disposed of in a burial container. Return flushing is also required for waste in the recirculation leg, which would stagnate during a waste transfer to the solidification equipment. The incorporation of these design features can be seen in Fig. 3.

The recirculation mode also aids in the iterative fill process of liners. A recirculating waste slurry can be diverted to fill a liner. The slurry can be diverted to recirculation while the liner is being decanted and quickly diverted back to refill the liner after decanting has ceased.

A cycled condensate header was provided to the mobile solidification station for flush water. A decant line was also provided to the mobile solidification station. The decant line is routed back to an equipment drain processing collection tank.

The concentrated waste transfer lines will be flushed forward. The process of returning the flush water to the plant from these lines was abandoned in order to reduce piping costs. This compromise was -de because of the shorter length of transfer ' the anticipated performance of the -izers.

VALVE SELECTION

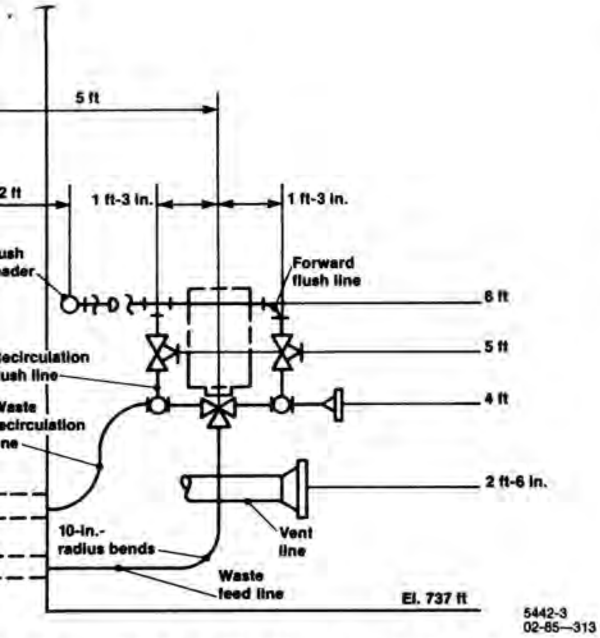
Plug- and ram-type valves are utilized throughout the Clinton solid radwaste system so that valve closure is not impaired by the presence of solids. Use of these valves also reduces crud buildup and thereby any related maintenance exposures. The modification requires a valve setup that allows flow diversion in several areas. Flow diversion is required in the new valve aisle in the future VR room so that waste can be sent to either the in-plant or the mobile solidification system. Flow diversion is also required at the mobile solidification station to send waste slurries to th mobile solidification equipment or back to the wast collection tanks.

Since the two sludge recirculation lines function as headers, flow diversion is also requ' near the collection tanks for RWCU and filter sludge. This enables waste to be recirculated t the tank from which it originated.

Three-way plug-type valves were selected diversion valves in all cases. The use of thr plug valves reduces the number of valves requ divert flow, and it also eliminates deadlegs. Operation of these valves in radwaste system been proven. Two-way plug valves were selec other slurry services in the modification.

MOBILE SOLIDIFICATION STATION

The mobile solidification station or station centralizes all the interface rec for waste processing. Several vendors w contacted to determine the interface rec which would allow maximum flexibility. to waste transfer lines and a decant l' other services are required. These in instrument air, service air, a ventila flush water, and electric power.[1] M systems also require cooling water.



ig. 3, Mobile solidification station piping detail section view.

An instrument air line and service air line are
ded at the mobile solidification station.
water is provided for the station by a tap in
ycled condensate supply header.

Cooling water supply and return lines were
ded at the mobile solidification station for
e VR services. These lines are a nominal 48-
meter (1-1/2 inch) size. The cooling water
are provided with isolation valves and end in
flanges that will interface with vendor-
led transfer hoses.

entilation requirements varied greatly among
bile services. Several vendors required about
s per second (5 scfm) of displacement air for
illing. One solidification service requires
rs per second (100 scfm), a 114-millimeter
line size, while a mobile VR service
94 liters per second (200 scfm), a 168-
r (6-inch) line size. Since a minimal cost
was incurred for the 168-millimeter (6-
versus the 114-millimeter (4-inch) line,
line was provided to support VR services.

ical requirements also varied greatly
services. All services require a 480-
hase supply. Some solidification ser-
a 100-amp feed, while others require
o and a 60-amp feed. Mobile VR ser-
power requirements of 200 kilowatts

lt, three-phase, 500-mcm line is
mobile solidification station from
bstation. Two fused disconnect
ided for maximum flexibility. A
th 110-amp fuses and a 60-amp
fuses are provided. A mobile VR
can be accomplished by replacing
n the 400-amp switch with larger

ones. The maximum load for this arrangement is 230 kilowatts at 460 volts (330 amps). Current-limiting fuses are provided to increase protection of the contractor's equipment from the high-fault currents that are possible at the station.

If provisions for mobile VR services were not provided, a 100-amp switch rather than the 400-amp switch and a smaller cable would have been used.

The space requirement of the waste transfer lines and associated interfaces at the mobile solidification station is about 3 x 2 meters (10 x 7 feet); see Fig. 4. For solidification contractors, additional space of 1.2 x 1 meters (4 x 3 feet) would be required for a local control panel, and of 1.5 x 1.5 meters (5 x 5 feet) for a decant pump skid. Mobile VR service equipment is anticipated to be trailer-mounted. The trailer(s) is expected to contain all the contractors' equipment.

CONTROL LOGIC AND NEW CONTROL PANEL

The existing control logic for the Clinton radwaste system features automatic tank recirculation, waste transfer, and flush sequences. Control panels for all liquid and solid radwaste equipment are located in the Radwaste Operation Center (ROC). The modification required a new control panel to facilitate mobile processing services. The interfacing panel, however, was not to affect the existing automatic control features.

Due to the complexity of the sludge and resin transfer operation, a semiautomatic control panel was selected for the mobile solidification station. This panel will be located in the ROC. Hand switches and a semi-graphic display are provided for each waste transfer line. The automatic tank recirculation sequence, which homogenizes the waste prior to transfer, will still be initiated at the existing control panel. A waste processing select switch is provided for each feed line on the new panel. These switches set a precedence in the valve lineup for either the in-plant solidification system or the mobile solidification station. A waste transfer to the mobile station can be initiated by turning these switches to the start position.

Since the three sludge waste streams have been headered together, a three-position feed selection switch is provided for each header. These switches set a precedence in the transfer and the recirculation valve lineup for the waste stream selected.

A three-position mobile station feed switch is provided for the sludge and resin transfer lines. These switches facilitate the iterative slurry feed and decant process for mobile solidification. The positions on the switch are as follows:

- Transfer - The divert valve is positioned to feed waste to the mobile solidification equipment.
- Recirc & Flush - The divert valve is positioned to recirculate the waste, and the vendor's hose is flushed.
- Trans & Flush - The divert valve is positioned to feed waste to the mobile solidification equipment, and the recirculation line is flushed.

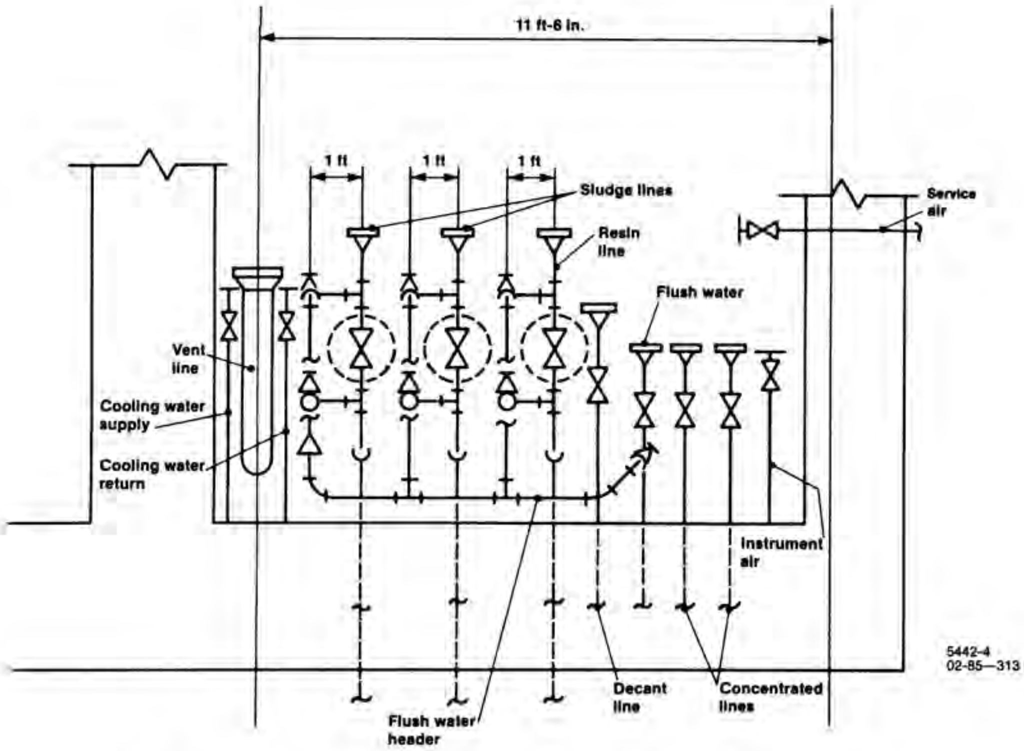


Fig. 4. Mobile solidification station piping detail plan view.

Since concentrates are flushed forward, a flush sequence switch for each transfer line rather than a feed/recirculation selection switch is provided.

CONCLUSIONS

There are several interface design considerations involved in a docking station for mobile solidification services. The additional interfaces required to support mobile VR focus on cooling water, electrical supply, and space. At Clinton, the additional support services for mobile VR were included. These additions were small in relation to the overall modification.

The provisions for mobile solidification services can ensure waste processing if in-plant systems are unavailable. These features also ensure that compliance with current and future regulations on waste forms can be achieved. The addition of support services for a mobile VR system enables mobile waste processing to improve or maintain the packaging capabilities at a station.

REFERENCES

1. R. M. LUGAR, "Interface Considerations for Mobile Radwaste Processing Services," ANS Winter Meeting, San Francisco, California, October 30-November 4, 1983.