SYSTEM DESIGN, CONSTRUCTION, AND START-UPOF THE HANFORD TRANSPORTABLE GROUT EQUIPMENT FACILITY

Henry Gaines, Jr.
ATI/US Ecology Nuclear
212 South Tryon, Suite 300
Charlotte, NC 28281
704-376-5752

M. C. Carrigan
Westinghouse Hanford Company
2750E 200E Area
P.O. Box 800
Richland, WA 99352
509-373-2822

ABSTRACT

The U.S. Department of Energy and Westinghouse Hanford Company (WHC) have developed a grouting process for the immobilization and final disposal of various mixed low level radioactive phosphate/sulfate wastes from the Hanford N-reactor operations. Associated Technologies, Inc. (ATI), now US Ecology Technologies Division, was selected to design, construct, and start-up the Transportable Grout Equipment (TGE) Facility with technical assistance from SGN of France.

The Processing facility was designed using a modular concept featuring totally remote maintenance capability where necessary. The unit is capable of processing waste with activity levels up to 1.75 Ci/liter.

The modules were fabricated and assembled off-site and transported to the Hanford site where they were installed in the prepared site. The units were then electrically and mechanically interconnected prior to testing.

The entire plant was put through a two phase Acceptance Test Program and then brought into "hot" operation on August 30, 1988. After processing approximately 450,000 gallons of grout, a single design modification was required on the surge tank vent between the grout mixer and grout pump.

Following the installation of the redesigned surge tank vent assembly, the unit will be restarted for continued operation.

INTRODUCTION

The U.S. Department of Energy and Westinghouse Hanford Company (WHC) have developed a grouting process for the immobilization and final disposal of

various mixed low level radioactive phosphate/sulfate wastes from the Hanford N-reactor operations. Associated Technologies, Inc. (ATI), now part of US Ecology Nuclear, was selected to design, construct, and start-up the Transportable Grout Equipment (TGE) Facility with technical assistance from SGN of France.

DESIGN

TGE was designed to be a modular facility capable of safely solidifying waste with activity levels up to 1.75 Ci/liter. The applicable modules have remote maintenance features. The system is controlled with an optimum balance of automatic and operator initiated controls. Process control is performed by a PLC while interfacing is performed with a keyboard and CRT.

The various subsystems in modular form are the dry blend system, decon & addi- tive module, liquid collection tank/mixer module, control room module, electrical equipment module, electric substation, filtration module, and stand-by generator.

THE PROCESS

Pre-blended dry grout is pneumatically transported from a delivery truck into the dry blend storage bin. In an adjustable and controlled rate dry blend material is delivered into the grout mixer. Liquids are transferred from storage into liquid collection tanks where the liquids are homogenized, sampled, and adjusted for pH, if required. The liquids are pumped at a ratio controlled rate into the grout mixer.

The homogeneous grout slurry is deposited in a surge tank which provides a constant supply of materials for the grout pump. The grout pump is capable of delivering up to 265 1/m off slurry to DOE supplied underground concrete and lined vaults for permanent storage.

Included in the process is a decon and additive system for process chemical adjustment of the liquids and for decontamination and flush of the system for upset conditions and maintenance.

MODULE FABRICATION

TGE had been designed to be transportable in eight functional modules:

1. Dry Blend System 2. Decon and Additive Module 3. Liquid Collection Tank/Mixer Module 4. Control Room

Module 5. Electrical Equipment Module 6. Electrical Substation 7. Stand-by Generator 8. Filtration Module

These individual units range from speciality fabrications to customized modular buildings to conventional skid mounted equipment.

CONSTRUCTION

The LCT/Mixer Module is placed in a subterranean concrete pit to provide shielding from the high radiation components. Construction was performed in two phases. Phase I was the site work and concrete pour. Phase II was the erection of the steel work and the installation of the prefabricated modules.

The TGE is an NQA-1 project and therefore very strict in terms of soil compaction and aggregate quality.

Tolerances for the LCT/Mixer Module and Motor Pit were very tight and took precision forming to meet.

Erection of the Dry Blend Tower steel and placement of the major components in the Dry Blend System went very quickly. Only the finishing work of the hand- rails, stairways, and toe plates took longer than expected.

The placement of the very complex and tight tolerance LCT/Mixer Module took only one day to place into the pit and shim in place. The Decon and Additive Module, Control Room Module, Electrical Equipment Module. Substation, and Generator were set in place in the space of one week. The time consuming portion of Phase II construction became the welding of the interconnecting piping be- tween the LCT/Mixer Module and the Decon Additive Module. Also the welding of the piping to the jumpers (special Hanford designed remote disconnects) proved to be more extensive than originally anticipated. In the middle of Phase II construction, a major design change impacted construction. It was determined to be an operational and construction advantage to build a pipe chase adjacent to the two modules rather than bury the piping along side the modules. This design change delayed the completion of construction. Construction was substantially complete (95%) November 30, 1987.

ACCEPTANCE TEST PROGRAM

The Acceptance Test Program (ATP) was also divided into phases. Phase I was the Pre-Acceptance Test check-out where components and instruments were calibrated and tested for repeatability for the full range of functional usage. Every component or instrument was not only checked in the field for functional compliance but also for panel and graphic accuracy. If a tank was filled 50%, the graphic and panel instruments must also verify that the tank was 50% full. If a valve was actuated to a fully open position the field the panel had to verify the same. Phase I ATP's were completed January 6, 1988.

Phase II ATP's required complete logic check-out and demonstration of the TGE's ability to produce grout. With test crews working around-the-clock to support the DOE schedule, logic check-out including interlock and alarm functions was performed in less time expected.

Each component system was run individually to demonstrate operation. Establishing controlled flow of the dry grout solids was the most difficult of the start-up problems. Packing of the material was experienced until proper adjustments were made and an arrangement of aeration nozzles installed in the storage bin cone. End play adjustment was also required on the mixer shafts to obtain proper operation.

The initial integrated system test was successfully performed on January 26th. After a detailed briefing on the start-up procedure, the controlled startup was initiated on a dilute grout mix of approximately 0.9 kilograms of dry solids per liter of water. Personnel stationed at vital points throughout the facility were equipped with two-way radios to maintain constant communication with the control room. This twenty minute run was followed by an orderly shutdown and a fifteen minute system flush. The post-operation component check revealed no unacceptable grout build-up anywhere in the system.

Over the next several weeks additional test runs were made gradually increasing the grout to liquid ratio to 1.20 kilograms of solids per liter of water. These successful demonstrations set the stage for the ten (10) hour sustained production run required by the system acceptance criteria.

The ten (10) hour campaign was conducted on February 9, 1988. The liquid feed was a synthetic phosphate/sulfate waste solution prepared to simulate the first of the planned radioactive streams schedules for processing. Operating at a nominal 265 liters per minute of grout production the system produced ap- proximately 159,000 liters of test grout. Solids-to-liquid ratios were varied over the run to demonstrate the versatility required by the test procedures. The system performed properly without exception. There were not system upsets or downtime experienced.

The grout production was followed by a demonstration of the remote disassembly/re-assembly of the LCT/Mixer Module components. Using an impact wrench suspended from a crane hook and standard Hanford work practices of this type operation all interconnecting piping and electrical conduit jumpers were removed from the processing module. All equipment assemblies were loosened, lifted to demonstrate balance and fit, the re-set on their prescribed bases. Jumpers were then replaced. This final procedure of the ATP was extensively photographed and videotaped for use in training future operations and maintenance crews.

Following completion of the ATP, several weeks were spent completing punchlist items of construction and in implementing design enhancements requested by WHC. On May 2, 1988 WHC assumed operational control of the facility. Hot operation of the facility began August 30, 1988. The first series of waste consisted of phosphate and sulfate waste resulting from decontamination operations around the Hanford Site. Although the activity level was low, the

operation did prove that the TGE was capable of running on active waste and that the tested procedures and equipment met or exceeded design requirements.

The most serious problem of the startup was encountered shortly after the ten (10) hour grout production campaign. During a system decontamination run the progressive cavity grout pump was found to be inoperable. The rotor and stator were determined to be bound and could not be turned by the drive motor. The pump was removed and returned to the manufacturer where it was determined that at elevated temperatures the high pH TURCO decontamination solution was attacking both the chrome-plated surface of the stainless steel rotor and the elastomer material of the stator. The rotor has been modified to eliminate the chrome plating, using instead a polished surface on the 304 stainless steel base material. Also, inspection and selectively has been increased on the compressive fit property of the stator. The modified pump has been in- stalled and successfully operated.

The only significant problem which arose during the first active campaign was a plugging phenomenon the surge tank vent off-take which was not evident during cold testing. The problem has been identified as two fold. The first being that of excessive venting velocity through the dry blend feed chute and grout mixer and the second being an active wet-dry interface immediately in- side the vent off-take. A redesigned dilution heater arrangement has been designed which will bleed in necessary make up air at the surge tank off-take. The air will be preheated and mixed with the reduced flow through the dry blend feed via specially designed blending header.

CONCLUSION

The turnover of the TGE Facility to Westinghouse Hanford concluded a twenty- six month effort to design, construct, and demonstrate the first production operation for the permanent disposal of Hanford's defense program low-level radioactive wastes. Continuing operations will further prove the TGE's capabilities as hot operations resume in the coming months.

DISCLAIMER