ORNL/CP-98305

CONF-980905--

Processing Mixed-Waste Compressed-Gas Cylinders at the Oak Ridge Reservation

M. I. Morris
T. B. Conley
I. W. Osborne-Lee

SPECTRUM '98
Denver, Colorado
September 13–18, 1998

Prepared by the
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee
Managed by
LOCKHEED MARTIN ENERGY RESEARCH CORPORATION
for the
U.S. Department of Energy
under contract DE-AC05-96OR22464

DISCLAIMER

Processing Mixed-Waste Compressed-Gas Cylinders at the Oak Ridge Reservation

M. I. Morris, T. B. Conley, and I. W. Osborne-Lee

Oak Ridge National Laboratory
Post Office Box 2008
Oak Ridge, Tennessee 37830-6180

1. INTRODUCTION

Until recently, several thousand kilograms of compressed gases were stored at the Oak Ridge Reservation (ORR), in Oak Ridge, Tennessee, because these cylinders could not be taken off-site in their state of configuration for disposal. Restrictions on the storage of old compressed-gas cylinders compelled the Waste Management Organization of Lockheed Martin Energy Systems, Inc. (LMES) to dispose of these materials. Furthermore, a milestone in the *ORR Site Treatment Plan*[1] required repackaging and shipment off-site of 21 cylinders by September 30, 1997. A pilot project, coordinated by the Chemical Technology Division (CTD) at the Oak Ridge National Laboratory (ORNL), was undertaken to evaluate and recontainerize or neutralize these cylinders, which are mixed waste, to meet that milestone.

The U.S. Environmental Protection Agency (EPA), U.S. Nuclear Regulatory Commission (NRC), and U.S. Department of Energy (DOE) share responsibility for mixed waste and so must work together to streamline its regulation and resolve conflicts among federal regulations. The Federal Facilities Compliance Agreement (FFCA), passed by Congress in 1992, requires EPA to develop treatment requirements for mixed waste. To this end, each DOE site has developed a treatment plan for its mixed waste.

Disposition of mixed waste is particularly problematic because two sets of regulations apply to its management—those for hazardous waste and those for radioactive waste. Under federal and state land disposal restrictions, land disposal of gas cylinders that constitute mixed waste is not an option. The most effective approach to dealing with this problem is to separate the hazardous component of the waste from the radioactive component. The results would be (a) one waste that can be disposed according to EPA rules and (b) another waste that can be disposed according to NRC rules. For this project, it was decided that the contents of the mixed-waste cylinders must be repackaged to eliminate the radiological component of the waste so that the cylinders could then be neutralized at the facility or disposed of off-site as hazardous waste. This was the most feasible route, since the mixed waste in question consisted of a hazardous material found on the outside of a cylinder which had become contaminated with radioactive material at some point during its life. Because the radiological component was considered to be confined to the exterior of the cylinder, the contents (once removed from the cylinder) could be handled as hazardous waste, and the cylinder could be handled as low-level waste (LLW).
This pilot project to process 21 cylinders was important because of its potential impact. The successful completion of the project provides a newly demonstrated technology which can now be used to process the thousands of additional cylinders in inventory across the DOE complex. In this paper, many of the various aspects of implementing this project, including hurdles encountered and the lessons learned in overcoming them, are reported.

2. TRANSPORTABLE COMPRESSED-GAS RECONTAINERIZATION SKID (TCGRS)

The equipment to process the cylinders was donated by the Mixed Waste Focus Area (MWFA), a program management function of DOE charged with providing acceptable technologies to implement mixed-waste treatment systems across the DOE complex. Under FFCA, DOE is committed to developing plans and deploying facilities to treat its mixed wastes. The equipment to breach the cylinders, TCGRS, was originally designed and built by Integrated Environmental Services (IES) of Atlanta. IES was selected as the contractor for this demonstration project and was contracted to set up, operate, decontaminate, and package the TCGRS equipment for storage. IES also agreed to provide an environmental enclosure for the equipment, a mobile laboratory for the necessary analyses, and the following auxiliary equipment:

- a neutralization system,
- off-gas scrubbers,
- glove boxes, and
- a cryogenic freezing system

The TCGRS is a transportable system which can perform the following functions:

- sample, analyze, and identify at the site the chemical and radiological content of each cylinder, even those with inoperable valves;
- breach cylinders when necessary to release their contents into a containment chamber; and
- provide for neutralization of the fluid contents (gas or liquid) within the containment or transfer the fluid to a new cylinder, whichever is required.

Once processed by the TCGRS, old cylinders and cylinder fragments are disposed of as LLW. The gas cylinder contents are either neutralized or repackaged, now considered as Resource Conservation and Recovery Act (RCRA) waste, and shipped off-site for treatment and disposal.

The TCGRS was moved by truck from Atlanta, Georgia, to the East Tennessee Technology Park (ETTP), one of three DOE sites at the ORR, and set up in a demonstration area. Utilities were supplied to the project site, and a test run of the system was conducted in August 1997. Full operation began and was completed in August 1997 over a period of 5 d.

3. SELF-ASSESSMENT

Although the actual processing of cylinders spanned only a few days, our preparation of the way for the project required months of work. The project had to comply with an extensive list of federal, state, and site-based regulations and standards. Dozens of agencies and site organizations were required to sign off on the plans before operation could begin. Managers of the project used a self-assessment process (a) to ensure that the TCGRS was ready for safe startup and operation and (b) to coordinate the environmental, safety, and health documentation necessary to satisfy stringent DOE, Tennessee Department of Environment and Conservation (TDEC), and company requirements. The self-assessment process is based on a readiness self-assessment checklist that tracks numerous aspects of the acquisition and operation of the TCGRS on-site. The six-page checklist breaks the process down into dozens of discrete tasks, from the inception of the contract with the vendor to the shutdown and storage of the system. The checklist also supplies start and finish dates, durations, prerequisite tasks, and a status indicator for each task.

The self-assessment checklist seeks to address every issue associated with the process from the perspective of all regulations and procedures that might apply [e.g., Occupational Safety and Health Administration (OSHA), clean water and clean air acts, National Environmental Policy Act (NEPA), RCRA, site health and safety (H&S) procedures, TDEC regulations, and applicable DOE standards and procedures].

There were two levels of compliance to the self-assessment process: site-level and division-level. Site-level compliance encompassed the following elements:

- Facility safety
- Radiation control (RADCON)—radiation control officer (RCO)
- OSHA/industrial safety
- Industrial hygiene
- Transportation safety
- RCRA

- Clean Air Act
- NEPA
- Hazardous materials information system (HMIS)
- LLW
- Satellite storage area (SSA)
- Sanitary waste
- Spill control
- Safeguards

Division-level compliance encompassed the following elements:

- Conduct of operations
- Configuration management
- Quality assurance (QA)
- H&S
- Environmental compliance
- Training
- Waste tracking

Those persons responsible for overseeing compliance with each of these regulations and standards were required to evaluate the project plans and preparations and the documentation relevant to their responsibilities. Some conducted on-site inspections or walk-downs to check equipment, records, and site preparation. If the inspectors were not satisfied with their findings, the project managers were notified of what must be done to obtain approval. Once satisfied, the inspectors signed off on their respective areas. The project could begin operation only after all the signatures were obtained, showing that all issues had been addressed satisfactorily.

3.1. Hurdles and Issues

Disposition of these gas cylinders was challenging, primarily because of the hazards and uncertainties which tended to exacerbate the risks posed by those hazards. The H&S requirements, in combination with these risks, led to a number of hurdles which had to be overcome and issues which had to be resolved. The checklist used for the self-assessment was the key instrument in identifying hurdles and issues.

3.2. Current Status

The pilot project to treat 21 cylinders was completed with great success. Since then, an additional 68 cylinders have been processed and disposed, bringing the total cylinders processed so far to 88. To process the additional cylinders, the original safety documentation first had to be upgraded to address the expanded project scope. Capabilities were added to the system—for the venting of inert gases without the requirement of an air permit, for example. Currently, the scope of documentation for the system is being further expanded to permit processing of flammables and unknowns.

4. CONCLUSIONS

The original pilot project to treat 21 cylinders was completed with such success that additional cylinders were processed. The self-assessment approach used was effective in ensuring a safe and an effective operation, environmental protection, and regulatory compliance. Although the assessment was very thorough in its scope and significant effort was required to address all the H&S issues, the checklist method was an effective tool for organizing and streamlining the self-assessment process. The cost to this stage of technology development has been notable at $1,240,000. For the original scope of the pilot project, the cost of over $1 million may seem expensive. However, as expected, incremental costs and schedules for processing additional cylinders were found to be significantly reduced. Further economic gains are expected for future processing operations.

The way is now open for wider application of the TCGRS technology. Once the documentation has been revised to address a wider range cylinder types, the equipment can be used to process the approximately 1000 cylinders at the ORR as they become surplus. Beyond the ORR, there are many other DOE sites at which gas-cylinder disposition is a problem. At Oak Ridge, the solution to this problem now exists in the form of the TCGRS—the only proven, safe alternative for repackaging, recontainerization, or neutralization of cylinders.

5. REFERENCES

1. *ORR Site Treatment Plan* issued by the State of Tennessee's Department of Environmental and Conservation pursuant to Sect. 3021(b) of Resource Conservation and Recovery Act, 42 U.S.C. 6936(c), as amended by the Federal Facility Compliance Act, and Tennessee Code Annotated Sect. 68-212-111.

ORNL/DWG 97-128281

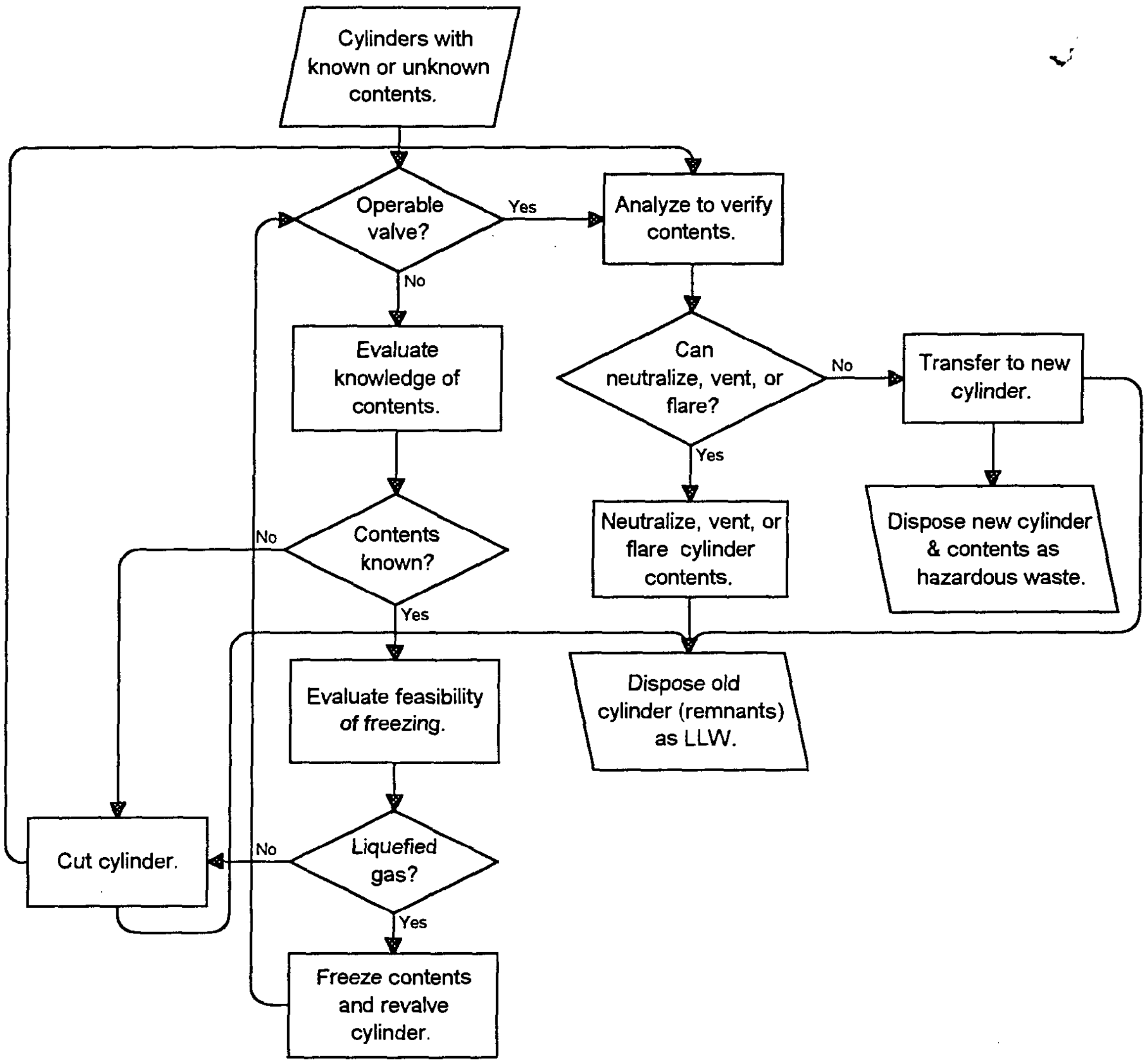

Figure 1. Logic for processing gas cylinders with the TCGRS.

Table I. Cylinder disposition log for the TCGRS demonstration.

No.	RFD Description	Analysis results	Disposition
1	Fluorine (F_2)	Empty	LLW
2	F_2	Tetrafluorosilane	Neutralized
3	Chlorine (Cl_2)	Cl_2	Neutralized
4	Chlorine monofluoride (ClF)	Empty	LLW
5	Chlorine trifluoride (ClF_3)	ClF_3	Neutralized
6	Hydrogen fluoride (HF)	HF	Neutralized
7	Empty	Empty	LLW
8	Air/chlorotrifluoromethane (CF_3Cl) (freon)	Silicon tetrafluoride	Neutralized
9	Nitrogen dioxide (NO_2)	Empty	LLW
10	NO_2	NO_2	Neutralized
11	NO_2	Empty	LLW
12	NO_2	NO_2	Neutralized
13	Cl_2 suspected	Dimethyloxy-silane	Neutralized
14	Carbonyl difluoride	Carbonyl difluoride	Neutralized
15	Chlorotrifluoromethane	Silicon tetrafluoride	Neutralized
16	Chlorine suspected	Cl_2	Neutralized
17	Chlorotrifluoromethane	Silane	Neutralized
18	Air	Empty	LLW
19	Hydrogen fluoride	Empty	LLW
20	Antimony pentafluoride	No analysis performed	Ship to Rollins Disposal Facility as is
21	Carbonyl difluoride	Empty	LLW

Table II. Training requirements for division-level compliance

Training description	Duration, h
Hazardous waste operations and emergency response (HAZWOPER)	40
Radiation Worker II	40
General employee training	4
Security	1
Hazardous materials satellite area	4
Facility emergency warden and station director	1
Prescreening training review	1
Vendor-specific training	20
Total	111

Table III. Hurdles and issues faced in the disposition of gas cylinders

Hurdle/issue	Description	Source of problem	Resolution
Cylinder management device	Device would not hold pressure	Flanges machined improperly	Returned to manufacturer for repair
Pressure (American Society of Mechanical Engineers) code stamping	Device was code-stamped and certified, but would not hold pressure	Wrong gasket was used in American Society of Mechanical Engineers (ASME) test	Returned to manufacturer for repair
Hydraulic fluid	Issue of compatibility of hydraulic fluid with some cylinder contents	ClF_3 is a pyrophoric material	Analysis showed low risk of contact with incompatible materials
Breakout doors	Zipper doors not adequate for emergency preparedness	Lack of breakout doors in case of emergency	Breakout doors installed
Fire department versus sprinkler	Building code required sprinkler system none was available	Inability to meet building code requirement	Substituted fire fighters manning charged hoses (with DOE approval) while sprinkler system was being added
Warning alarm	Emergency evacuation horn was required	Lack of horn or other alert measure	Purchased and installed the required horn
Electrical safety and hookups	Explosion-proof electrical system required for handling of flammable materials	Building code not met due to prohibitive upgrade cost	Flammable gases not handled in this project; future runs will flare such gases outside of system
Personnel protective equipment (PPE)	Vendor's total dress-out equipment was different than site-approved personal protective equipment (PPE)	Equivalence and acceptability were not established	Analysis of manufac-turer's specifications showed vendor's equipment to be better
Laboratory equipment	Lab equipment would not function, with no time to troubleshoot	Defective equipment, tight scheduling	Vendor's equipment (mobile lab) was brought in and used instead

Table III. Hurdles and issues faced in the disposition of gas cylinders (continued)

Hurdle/issue	Description	Source of problem	Resolution
Security (road washout vs exclusion area)	Access road to site was washed out, so only access was through secure area of plant	Project site gained new security requirements	Escorts were hired for personnel without security clearance while road repairs were made
Cylinder transport on-site	Project plans to transport cylinders were prepared assuming the cylinders were waste	Distinction between waste and nonwaste which have different requirements	New plans were prepared, documented, and approved for cylinders not declared as waste

Table IV. Project schedule elements

Schedule element	Date (Duration)
Idea conceived—International Desalination and Environmental Association Conference, LANL	1988
Project initiated—MWFA/LANL	1992
LMES gets involved	1995 (2 years)
Preparation for initial (Phase I) cylinder disposition operation at Oak Ridge	April 1997 (5 months)
Actual processing of 21 cylinders (Phase I)	August 1997 (5 d)
Processing of 18 additional cylinders (Phase II)	September 1997 (6 d)
Processing of 49 additional cylinders (Phase III)	March 1998 (10 d)
Preparations for processing of up to 1,000 cylinders (Phase IV)	Now underway, target date: August 98

Table V. Project costs

Cost element	Cost, $ (1,000)
Equipment	710
Vendor-based contracts (installation and operation)	140
Vendor additions	40
Project support	350
Total	1,240

Report Number (14) ORNL/CP--98305
CONF-980905--

Publ. Date (11) 199805

Sponsor Code (18) DOE, XF

UC Category (19) UC-900, DOE/ER

DOE