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UCRL - 76560
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LAWRENCE LIVERMORE LABORATORY
University of California/Livermore, California

LLL'S QUALITY ASSURANCE PROGRAM AND THE
DESIGN OF SPECIFIC SYSTEMS - TRITIUM HANDLING FACILITY*

Jerry P. Dow

February 19, 1975

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RECEIVED BY TIC OCT 3 1975

This paper was prepared for submission to
the DAMSUL Committee Meeting
SRP, November, 1974

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* Work performed under the auspices of the US-ERDA.

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Jerry P. Dow
Lawrence Livermore Laboratory
Livermore, California

INTRODUCTION

Lawrence Livermore Laboratory operates a Tritium Handling Facility (Building 331) for several programs. Besides the tritium work for the Weapons program, basic research is conducted on all phases of tritium. Additional work is being conducted for the laser fusion program and the controlled thermonuclear program.

In the fall of 1971, approximately 30 grams of tritium was accidentally released from the facility. The failure of a metal gasket was the cause of the release. The failure mode was determined to be hydrogen embrittlement.

The impact of the release on the Laboratory was felt immediately in the limitation of the tritium related work that could be performed in Building 331. As a result of this release, new operating procedures were immediately introduced and operations involving a higher potential of accidental release were either prohibited or significantly changed.

Another result of the release came in the form of a new directive from James Olsen, Plant Manager of the Laboratory. His directive established a Quality Assurance Program for critical facilities.

The remainder of this paper presents the LLL Quality Assurance Program for the tritium facility and how it is being implemented on specific tritium handling systems.

LLL QUALITY ASSURANCE PROGRAM

The LLL Quality Assurance Program is intended to prevent or mitigate the consequences of accidents by rigidly controlling the design, fabrication, procurement, construction and operation of safety-related critical structures, systems, and components of such facilities. The tritium facility at LLL is included in this program by definition: Certain facilities operated by the Lawrence Livermore Laboratory have, by the nature of the operation or due to contained hazardous materials, a potential for an accident that could cause serious risk to the public, Laboratory personnel, and to facility personnel.

J. OLSEN QUALITY ASSURANCE MEMO

A memo was received from J. Olsen on August 22, 1972, which gave detailed definition to the Quality Assurance Program at LLL. His memo, or document, was rewritten from several existing AEC reports: 10CRF50 Appendix B,

ANSU N 45.2, RDT F2-2T, M-94. These documents were originally written for quality assurance program requirements for nuclear plants.

The memo has seventeen major headings that will be addressed separately below:

1. Introduction - Defines the tritium facility (Building 331) as a critical facility.
2. Definitions - This section defines critical structures, systems, components, quality assurance, quality control, and safety related functions.
3. Scope - Establishes responsibility of QA Program. Applies to modifications, additions, replacements, and maintenance for critical structures, systems or components.
4. Organization - Establishes the responsible organization and their review responsibilities on the QA Program.
5. Design Control - Includes determination and use of codes and standards for critical systems. Design control includes provisions to assure that appropriate quality standards are specified and included in design documents and that deviations from such standards are controlled. Measures are also established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of the structures, systems, and components.
6. Procurement Document Control - Control of vendors and contractors to provide a quality assurance program consistent with ours.
7. Instructions, Procedures, and Drawings - All instructions affecting quality must be written.
8. Document Control - Control of documented assemblies and changes to assemblies.
9. Control of Purchased Material, Equipment, and Services - In-house inspections.
10. Identification and Control of Materials, Parts, and Components - Prevents the use of incorrect materials.
11. Control of Special Processes - Special processes must be performed by qualified personnel. Processes include welding, non-destructive testing, heat treating, etc.
12. Inspection - The worker is not the inspector.
13. Test Control - Establishes the need for a special testing program of systems both before and after operating of systems.
14. Control of Measuring and Test Equipment - To be included in operating procedures.
15. Handling, Storage, and Shipping - Provide special protective environments and cleaning procedures.
16. Inspection, Tests, and Operating Status - Tagging valves, systems, etc., to prevent incorrect operations. Training program.
17. Nonconforming Materials, Parts or Components - Prevents inadvertent use of nonconforming materials, or their individual acceptance by proper review procedures.

OPERATIONAL GUIDELINES FOR TRITIUM FACILITY

It became apparent very shortly after the J. Olsen memo that the total prevention of all tritium releases, no matter how small, cannot be accomplished. Simple maintenance of systems release a small amount of tritium and outgassing is always a problem. The total tritium released per

year could be reduced by procedure changes but a no leak philosophy was impossible.

Operational guidelines for the tritium facility were established and approved by J. Olsen on November 19, 1973. The guidelines establish a working definition of significant tritium with respect to a potential release to the atmosphere. The guidelines provide the design engineers with information necessary to determine if a system must be "certified" or documented in the Quality Assurance Program. The guidelines are:

1. Systems with a maximum potential release of less than 0.1g ($\approx 1,000$ CI) regardless of operating pressure need not be certified and are not considered critical.
2. Systems with a maximum potential release of less than 1g ($\approx 10,000$ CI) at pressures less than 414 KPa (60 PSIA) need not be certified and are not considered critical systems.

A potential release does not necessarily mean all tritium contained in a given system. For example, a system may be designed so that if any part failed, the release will not be above the maximum because of system isolation or operating procedures.

PERFORMANCE OF THE QUALITY ASSURANCE PROGRAM

A large amount of ground work has been accomplished to perform the QA program as outlined by J. Olsen. A decision was made early in the program to use the best available material and techniques to construct the certified systems and sub-assemblies. The word "available" is defined as: In existence but not possibly immediately available from vendors.

Input from the metallurgist assigned to this task (Phil Landon) became a very important part of the program. Much time was expended on development of vendors that would deliver materials by new specifications. In conjunction with others at the Laboratory, several specifications were written for basic materials. MEL 71-001168A is an in-house specification for 316 Stainless Steel. Stainless steel tubing is covered under MEL 71-001150C or MEL 611L. Welding procedures are covered under ENR 72-17 and END 72-27. The welding procedures include the certification of the welder, welding machine, inspection and testing of a number of types of welds.

Two basic documents have been written that discuss the certified gas systems documentation and documentation control, and certified gas systems quality control (ENR 74-1 and ENR 74-2). Testing of systems is covered in ENR 72-920. Safety notes are required on all subassemblies. Secondary containment requirements use ASME Sections VIII and IX as guidelines.

A certified fittings storeroom has been established to control the use of certified parts and subassemblies. The storeroom has the responsibility to interact with contractors on procurement and do all the in-house inspection of materials storehouse for all certified material and parts at LLL.

DESCRIPTIONS OF MODIFICATIONS

The systems existing in the tritium facility were examined and a deter-

mination was made if the system or parts of the system should be fully certified. Twelve systems were identified to be reworked in the QA program and are listed below along with their use.

1. Pumping Station - Certified System - Capable of pumping 5000 PSI tritium with a totally enclosed diaphragm compressor and welded certified plumbing system. The system will be protected by rupture discs aborting to a low pressure containment system.

2. High Hazard Station - Certified System - This installation provides secondary containment for tritiated liquid operations.

3. Maintenance and Assembly Box - Non-Certified System - This system will provide a closed facility to perform maintenance of equipment to lessen the controlled releases. The small amounts of tritium will be captured as HTO on disposable molecular sieve traps.

4. Recovery System - Certified System - This system will be used to recover tritium for reuse if a leak to one of our secondary containment systems should occur. This system will also be used to scavenge small quantities of tritium in maintenance and assembly work. Some parts of this system will be non-certified.

5. Process Welder - Certified System - A welder to do process welding on coils presently welded at Savannah River.

6. Low Pressure System - Certified U Traps Only - This is a low pressure gas handling system that feeds the high pressure pumping station.

7. Laser Welder - Certified System - This will replace our existing system with an all-welded system.

8. Synthesis System - Partly Certified System - This will be a facility for metal tritide synthesis.

9. N₂ Cleanup Process - Non-Certified - This will equip the inert atmosphere glove boxes with process N₂ removal and will eliminate the 20 to 40 ci/month controlled release which now occurs when we pump the boxes to remove N₂.

10. Assembly Holding Station - Non-Certified - A secondary containment system for various temporary storage needs.

11. Panel Alarm System - Non-Certified - This system will concentrate alarms and controls at a central location to make building surveillance easier and more reliable.

12. Uninterruptable Power Supply - Non-Certified - This system provides our stock tritium monitoring equipment with transition power in the event of a power failure until the auxiliary generator comes to speed.

QA PROGRAM - MANPOWER AND COST

The latest manpower and cost estimates to perform the QA program in the tritium facility was made in December, 1973. The equipment and procurement will be approximately \$363,000 and the total cost including manpower will be approximately \$2 million. These figures are in 1973 dollars and represent a 39 man year effort expended over three years.

EXAMPLES OF QA DOCUMENTATION

A documentation scheme was devised to be able to trace each part that goes into a system back through each construction phase and eventually to the chemical composition of the metal used. The method used is called "marked print" method. Basically a print of the system or subassembly is made with

blanks to be filled in. Once the subassembly is completed and all the blanks are filled, the print is microfilmed and kept as a permanent record.

Figure 1 and 2 shows early attempts at this documentation scheme. Figure 1 is a documentation drawing for a Containment Tank Subassembly. Figure 2 is a documentation drawing for a Recovery Tank Subassembly. As can be seen by these two figures, they are simple subassemblies and not a difficult task for this scheme.

Figure 3, High Pressure Gas System Schematic, shows a very complex system. The documentation of this system is done by breaking down the system to a large number of sub-systems and documentation drawings are prepared on the smaller sections. Figure 4, Containment System Documentation Drawing, shows a typical documentation drawing for a portion of a more complex assembly shown in Figure 3.

SUMMARY

The QA program at LLL is now under full operation with a present staff of 15 people. It has been our experience that to fully certify assemblies, the extra dollars and time required is from 3-5 times the normal construction cost and time. This estimate only applies after all people are brought up to speed and are fully trained in the total documentation and certification schemes.

Eventually it boils down to putting the final trust in an individual, that he will do the job right and all proper procedures are followed. For this reason we have taken special care to select the people with the right temperament and attitude to perform the construction. The individuals must also be conscientious and responsible. They serve as checkers on each other's work and are instructed that the emphasis is on correctness, not speed.

As of this writing, the first fully certified system is about 95% complete. This system, the Pumping Station, was the most difficult of all the systems scoped. We have used it to establish our documentation and QA schemes and anticipate the remainder of the QA program to proceed at a much more rapid and smoother rate because of the experience and procedures established to date.