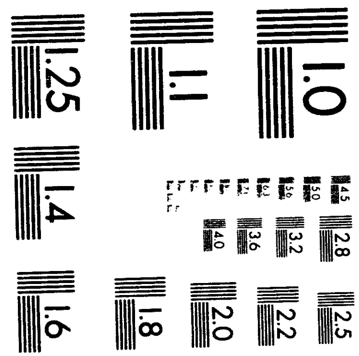
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Handling and Disposal of SP-100 Ground Test Nuclear Fuel and Equipment

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HANDLING AN DISPOSAL OF SP-100 GROUND TEST NUCLEAR FUEL AND EQUIPMENT

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Abstract

The post SP-100 reactor testing period will focus on defueling the reactor, packaging the various radioactive waste forms, and shipping this material to the appropriate locations. Remote-handling techniques will be developed to defuel the reactor. Packaging the spent fuel and activated reactor components is a challenge in itself. This paper presents an overview of the strategy, methods, and equipment that will be used during the closeout phase of nuclear testing.

INTRODUCTION

An important aspect of the SP-100 Ground Engineering System (GES) Test Site mission is the remote disassembly of the nuclear reactor and radioactive cell equipment following completion of the nuclear testing program. Disassembly, packaging, storage, and/or disposal of highly radioactive material is a sizable and complex undertaking. This paper presents an overview of the strategy, methods, and equipment that will be used to place the nuclear fuel and activated material into a safe and acceptable configuration.

BACKGROUND

Nuclear operation of the SP-100 reactor creates a significant quantity of highly radioactive fission material in the fuel assemblies. Many of these fission elements are energetic elements. The high-energy neutron flux fields generated in the lower reactor cell during testing will activate most incell equipment and materials (reactor vessel, piping, etc.). As a result, highly radioactive solid waste will be generated, along with the spent reactor fuel.

The Solid Waste Cycle

The solid waste material that will be produced by testing the SP-100 reactor is categorized as both low-level and high-level material. The low-level material will be slightly radioactive (up to 3 r/h contact) due to exposure from lower neutron flux fields in the upper Test Assembly (TA) cell. This material will consist of the upper TA structure and piping located above the facility and flight shield. Most of the low-level material will be removed by hands-on methods, loaded into burial boxes, and shipped to burial grounds on the Hanford Site.

High-level solid waste (hundreds of r/h at contact) will consist of activated test assembly components, irradiated reactor core components, and the spent reactor fuel assemblies.

Activated Niobium-1Zr material will be packaged and stored onsite in a shielded cask for future shipment to a repository facility. The need for interim storage arises from the high concentration of ^{94}Nb produced during operation of the SP-100 reactor.

Spent fuel assemblies will be removed from the core and packaged in stainless-steel containers. These containers will be loaded into a shielded cask. The cask will then be stored onsite for future shipment to a high-level waste repository facility.

Remote Disassembly of the Test Assembly

The SP-100 GES Test Site includes a hot cell within the 309 Building containment building. The hot cell is separated into an upper cell and a lower cell. The equipment in the upper-cell area is partially shielded from the lower reactor cell by the reactor flight shield and a facility shield. These shields prevent significant activation of the upper test article equipment.

Disassembly of the TA will start after the primary lithium coolant and the secondary sodium coolant loops have been drained and cleaned. During the cleaning period, shielding windows, remote manipulators, and remote equipment throughways will be installed in the upper test cell.

The disassembly will begin with the removal of the upper vacuum vessel from the test cell. Remote pipe cutting equipment operated by the manipulators and the overhead cell bridge crane will sever piping and instrumentation lines connected to the upper vacuum vessel. Remote impact wrenches will be used to remove vacuum vessel flange bolts and other fasteners.

After the upper vacuum vessel section has been removed from the cell through the cell ceiling bagout ring, remote tools will sever the TA heat exchanger, liquid metal surge tanks, and the two flow meters. This equipment is expected to be the most radioactive material in the upper cell and its presence would prevent manned entry into the cell. Once the most radioactive items are removed from the cell, facility operators will manually section, package, and remove the remaining pieces of the upper TA.

Several pieces of remote reactor-handling equipment will be installed in the upper test cell when the upper cell area has been cleaned. These components are the reactor's handling machinery, the reactor disassembly station, remote fuel canister welding station, and the fixture used to raise the reactor from the lower cell into the upper cell.

A lifting fixture will be remotely attached to the remaining section of the TA to access the SP-100 reactor. The lower TA section will be lifted upward to bring the reactor to a position above the upper TA cell floor. At this time, the reactor handling machine will be activated and will place a holding fixture around and under the reactor vessel.

Remote cutting tools will be used to sever the primary coolant piping close to the upper reactor flight shield. Remote tooling will then access and remove the bolts holding the reactor vessel to the flight shield. When the reactor is separated from the flight shield, the reactor handling machine, supporting the weight of the reactor, will be moved to a holding position near one of the cell walls. With the reactor out of the way, the remains of the TA will be lowered back into place and secured.

The SP-100 reactor vessel will then be transferred to the reactor disassembly station by the reactor handling machine. At the disassembly station, the bottom portion of the reactor vessel will be cut away so that the lower face of the reactor core and fuel assemblies are exposed. Special tooling will be used to pull the assemblies out of the core and place them into individual stainless steel containers. These containers will be welded shut and leak-tested before being placed in a shielded cask.

CONCLUSION

The program to remove and package the radioactive solid waste generated during the testing of the SP-100 reactor will require the support of many pieces of equipment designed for remote and hostile environments. Handling of spent fuel in a hot-cell environment is not a new operation; however, the disassembly of the SP-100 core will be an intricate task.

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