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TABLES

FIGURES

5. OPERATION SYSTEMS

5.1. Operation Description

This section describes typical operations for unloading spent fuel from the MVDS and for monitoring. The interlocks to ensure the proper operation of these steps are listed in Reference 1.

Spent fuel handling activities will not be performed when the ambient air temperature is less than 12 degrees F. The basis for this is brittle fracture prevention of the FSCs, and taking into account the reduced amount of decay heat that will be available for future spent fuel handling activities.

5.1.1. Narrative Description

5.1.1.1. Defueling Operations

The defueling operation normally starts with the charge face isolation valve positioned over an empty charge face location, the CLUP hatch cover removed, the CLUP adaptor plate removed and an operable crane outside the MVDS.

NOTE: As discussed in section 4.2.3.2, galvanic cell corrosion inside FSCs is theoretically possible, and this reaction could possibly generate hydrogen gas. For this reason, PSCo committed (Ref. 2), and DOE also commits, that no FSC will be handled, or its lid bolts removed, until a sample of the fuel storage atmosphere has been analyzed and determined not to contain a combustible gas mixture, or evacuated and purged with air to assure hydrogen concentrations are below flammable levels. If analysis identifies a flammable concentration of hydrogen in air, then the fuel storage container will be evacuated and purged with air prior to handling or removal of the lid bolts. If no significant hydrogen concentration is detected in the first six FSCs whose internal atmospheres are tested, then it will be assumed that the theoretical galvanic reaction is not occurring at a significant rate in the FSCs, and additional FSCs will not be tested.

5.1.2. Flowsheets

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The sequence of operations is as follows:

1. The trailer carrying an empty FSC in the shipping cask arrives at the MVDS.
2. Preliminary Health Physics survey.
3. Inspect trailer and personnel barrier for damage.
4. Remove personnel barrier and impact limiters.
5. Health Physics survey of shipping cask.

6. Inspect the shipping cask and trailer for damage.

7. Remove cask shipping tie-downs.

8. Position trailer in the MVDS TCRB.

9. Remove the shipping cask from the trailer and position it in the CLUP.

10. Remove the trailer from the MVDS and fasten seismic restraints onto shipping cask in the MVDS TCRB.

11. Remove the shipping cask outer closure.

12. Health Physics survey.

13. Verify that the DUP is in place.

14. Verify that the FSC lid bolts are properly installed.

15. Place the CLUP adaptor plate in position.

16. Place the CLUP hatch cover in place.

17. Bolt the DUP adapter to FSC lid DUP.

18. Place the CLUP isolation valve over the shipping cask using the crane.

19. Place the USPHD on the isolation valve using the crane.

20. Open the isolation valve.

21. Remove the FSC lid DUP using the USPHD.

22. Close the isolation valve.

23. Remove and park the USPHD using the crane.

24. Place and connect the CHM to the isolation valve at the CLUP using the MVDS crane.

25. Open the CHM and CLUP isolation valves.

26. Lift the empty FSC into CHM using the FSC grapple.

27. Close the isolation valves.

28. Place the CHM in its park location.

29. Bypass the CLUP isolation valve interlock.

30. Open the CLUP isolation valve.

31. Health Physics survey of interior of shipping cask.

32. Close the CLUP isolation valve.

33. Remove the CLUP isolation valve bypass device.

34. Transfer the loaded CHM to FSC vault module storage position using the MVDS crane.

35. Connect the CHM to the charge face isolation valve.

36. Open the CHM and charge face isolation valves.

37. Lower the empty FSC into its vault module storage position.

38. Close the CHM and charge face isolation valves.

39. Transfer the CHM to its parking position using the MVDS crane.

The empty FSC is now in the vault module storage location. The sequence proceeds to prepare the next location for removing a loaded FSC.

40. Place the SPHD loaded with the charge face shield plug on the charge face isolation valve using the MVDS crane.

41. Open the isolation valve.

42. Lower the shield plug into position on the charge face above the empty FSC in its storage position using the SPHD.

43. Close the isolation valve.

44. Remove and park the SPHD using the crane.

45. Transfer the isolation valve to the next vault storage position to remove a loaded FSC using the MVSC crane.

46. Place the SPHD on top of the isolation valve using the crane.

47. Open the isolation valve.

48. Remove the charge face shield plug using the SPHD.

49. Close the isolation valve.

50. Remove and park the SPHD loaded with the shield plug using the MVDS crane.

51. Update records of storage locations.

The sequence has completed the preparation of the next location of a loaded FSC for removal, and proceeds to transfer a loaded FSC to the shipping cask.

52. Place the CHM on and connect it to the charge face isolation valve using the crane.

53. Open the CHM and charge face isolation valves.

54. Lift the loaded FSC up into the CHM.

55. Close the CHM and charge face isolation valves.

56. Transfer the CHM to the CLUP using the MVDS crane and place it on top of the isolation valve.

57. Open the CHM and CLUP isolation valves.

58. Lower the loaded FSC into the shipping cask.

59. Close the CHM and CLUP isolation valves.

60. Disconnect and transfer the CHM to its parking position using the crane.

61. Place the USPHD containing FSC lid DUP on the CLUP isolation valve using the crane.

62. Open the CLUP isolation valve.

63. Lower the DUP into FSC lid.

64. Close the CLUP isolation valve.

65. Remove and park the USPHD using the crane.

66. Remove and park the CLUP isolation valve using the MVDS crane.

67. Remove the CLUP adapter plate from CLUP.

68. Remove the DUP adapter from depleted uranium plug.

69. Remove the "O" ring innerspace port cover from shipping cask outer closure.

70. Lift the shipping cask outer closure with crane.
71. Inspect shipping cask outer closure "O" rings.
72. Inspect and clean shipping cask seal area.
73. Install shipping cask outer closure on cask.
74. Torque outer closure on shipping cask.
75. Perform shipping cask outer closure "O" ring innerspace leak check.
76. Install "O" ring port cover.
77. Perform "O" ring port cover leak check.
78. Remove CLUP hatch cover.
79. Attach cask lifting device to crane and cask.
80. Remove seismic restraints.
81. Lift shipping cask.
82. Back trailer into MVDS TCRB.
83. Lower shipping cask onto trailer.
84. Health Physics initiate shipping survey.
85. Remove trailer with cask from MVDS TCRB.
86. Install cask tie-downs to fasten shipping cask to trailer.
87. Install impact limiters.
88. Install front impact limiter seal.
89. Install personnel barrier.
90. Health Physics complete shipping survey.
91. Prepare shipping documents.
92. Release the trailer for shipment.

The sequence is complete. The charge face location from which the loaded FSC was removed will be the location for the next empty FSC that returns from the spent fuel storage site.

For reference purposes, the sequence times associated with loading operations are specified in Table 5.1-1, and the operational loading sequence is illustrated in Figures 5.1-1a, 5.1-1b, and 5.1-1c. This information will be used for exposure estimates and procedure development for unloading the fuel from the FSV ISFSI.

5.1.3. Monitoring Operations

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It is not necessary to monitor the MVDS performance parameters because of the passive heat removal system, the margins on allowable fuel element temperature, and the margin of subcriticality during all normal and off-normal events.

ISFSI boundary radiation monitoring is described in Section 7.6.1.

The cooling air inlet structure and outlet chimney mesh will be inspected for gross obstructions. Any such obstructions will be removed.

It is not necessary to monitor the fuel containment boundary provided by the FSC because the construction materials will not degrade beyond the ASME allowable thresholds (see Section 4.2.1.3) during the licensed storage period. However, the FSC features that allow comprehensive leak checking during fuel loading operations can be utilized safely throughout the storage period to check the metallic O-ring integrity, without FSC removal from the vault module.

5.1.4. Criticality Prevention

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Criticality of the fuel stored in the MVDS is prevented by the inherent safe geometry of the array of FSCs within the vault module. The criticality analysis is described in Section 3.3.4.

5.1.5. Instrumentation

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The MVDS does not require instrumentation for monitoring cooling air flow, cooling air temperature, radiation or criticality. Instrumentation will be supplied for seismic monitoring. Seismic instrumentation will be used to determine the severity of seismic disturbances. This instrumentation will consist of a Triaxial Time-History Accelerograph which will measure earthquake acceleration.

The seismic instrument vendor's instructions for ensuring the continued accuracy of the instrument will be implemented. Responses to a seismic event will include estimating the seismic input to the MVDS and evaluating the MVDS for damage.

5.1.6. Maintenance

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The MVDS requires minimal maintenance during the long term storage period. This is due to the simplicity of the MVDS design.

5.1.6.1. Equipment Maintenance

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During the fuel storage period, the CHM will normally be bolted down on its storage pad except during training exercises and other planned activities. A local power supply will be available for periodic operation of the MVDS crane, CHM raise/lower mechanism, and control systems. The CLUP and charge face isolation valves and the SPHDs will remain on the charge face. The TCRB entrance will be typically closed. In this way all equipment can be preserved and be retrievable for use at any time. The volume above the charge face and the TCRB can be routinely accessed for inspection of the stored equipment.

5.1.6.2. Structural Maintenance

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Civil structure maintenance is not anticipated to be necessary during the storage period other than routine checking that the cooling air inlet structure and outlet chimney mesh are not blocked, particularly during heavy snow conditions. However, the effectiveness of the vault cooling system is not sensitive to partial blocking and will function satisfactorily with up to 95% area blockage, as described in Sections 8.1.2 and 8.2.8. Should any cracks or general degradation of the concrete be observed, they will be evaluated as to the effect on the structure and required repairs. All steelwork associated with the enclosure structure is accessible for inspection and repainting if necessary during the anticipated storage duration.

Table 5.1-1. MVDS Loading Operation Sequence Times.

Time Hrs	Min	Operation
	27.5	CLUP hatch cover removed
	42	Transfer cask transferred from trailer to CLUP
	24	CLUP hatch cover replaced
	15	Cask closure removed
	11	Cask shield ring positioned over cask
	20	DUP adaptor bolted to FSC lid DUP
	24	CLUP adaptor positioned at CLUP
	24	Isolation valve positioned at CLUP adaptor and bolted down
	48.5	FSC lid uranium shield removed
	26	CHM positioned at CLUP adaptor
	25.5	FSC lifted into CHM
	23*	CHM transferred to vault storage position isolation valve
	25.5	FSC lowered into storage position
	24*	CHM moved to parking position
	54.5	Charge face shield plug replaced
	22	Isolation valve moved to next storage position
	40.5	Charge face shield plug removed
	46.5*	CHM transferred to vault storage position isolation valve
	25.5	Empty FSC lifted into CHM
	23*	CHM transferred to CLUP
	25.5	Empty FSC lowered into cask
	13.5	CHM moved to parking position
	47.5	FSC lid uranium shield replaced
	24	Isolation valve removed from CLUP
	24	CLUP adapter removed from container load/unload port
	16.5	DUP adapter removed from DUP
	11	Cask shield ring removed
	18	Cask closure replaced
	24	CLUP hatch cover removed
	42	Transfer cask returned to trailer
	28.5	CLUP hatch cover replaced
14 h	6.5m	TOTAL time for a loading cycle starting with a full FSC in the transfer cask on the transporter, and finishing with an empty FSC in the transfer cask on the transporter

* Average times

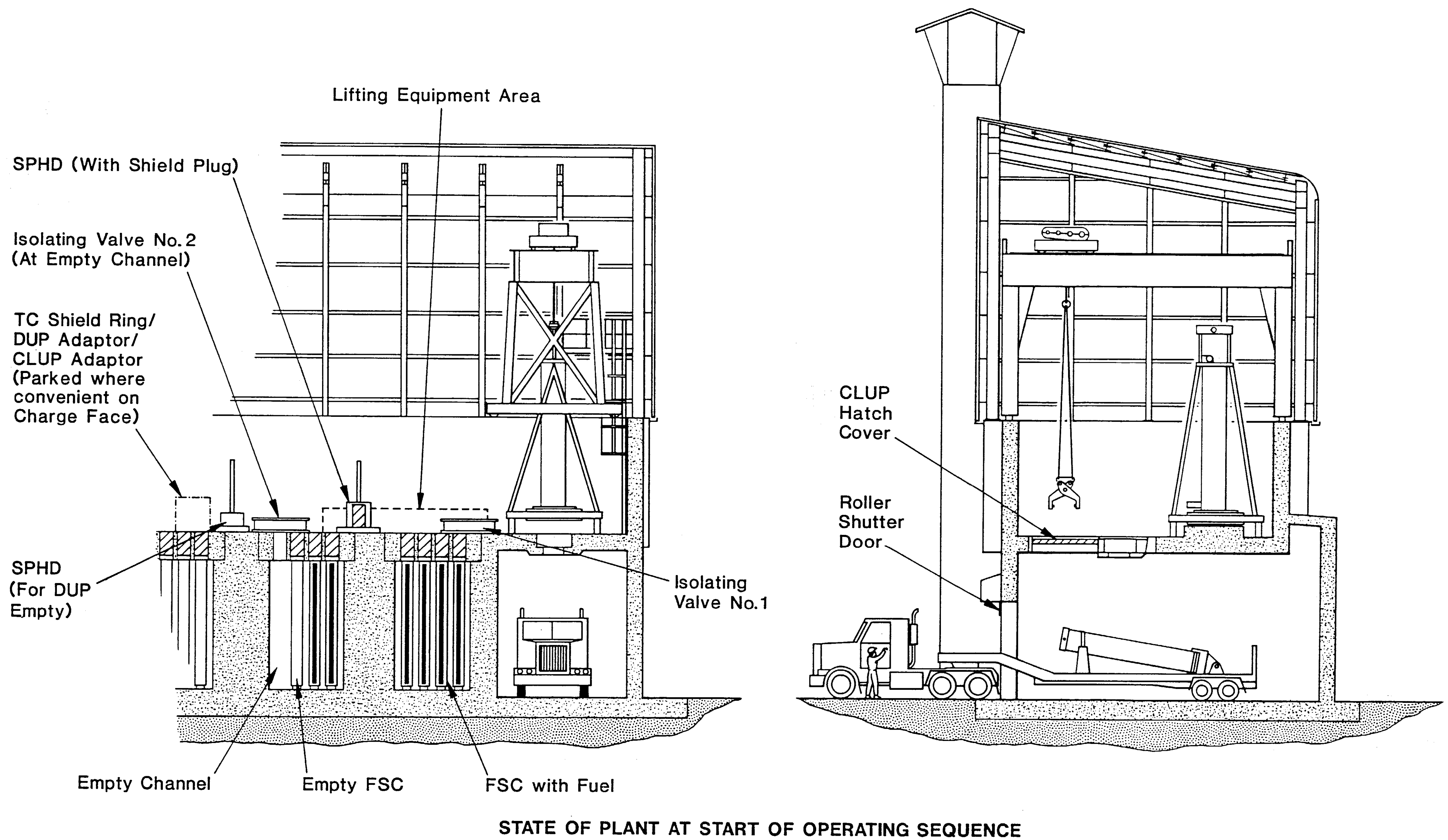

Figure 5.1-1a. Operating Sequence Flow Sheet.

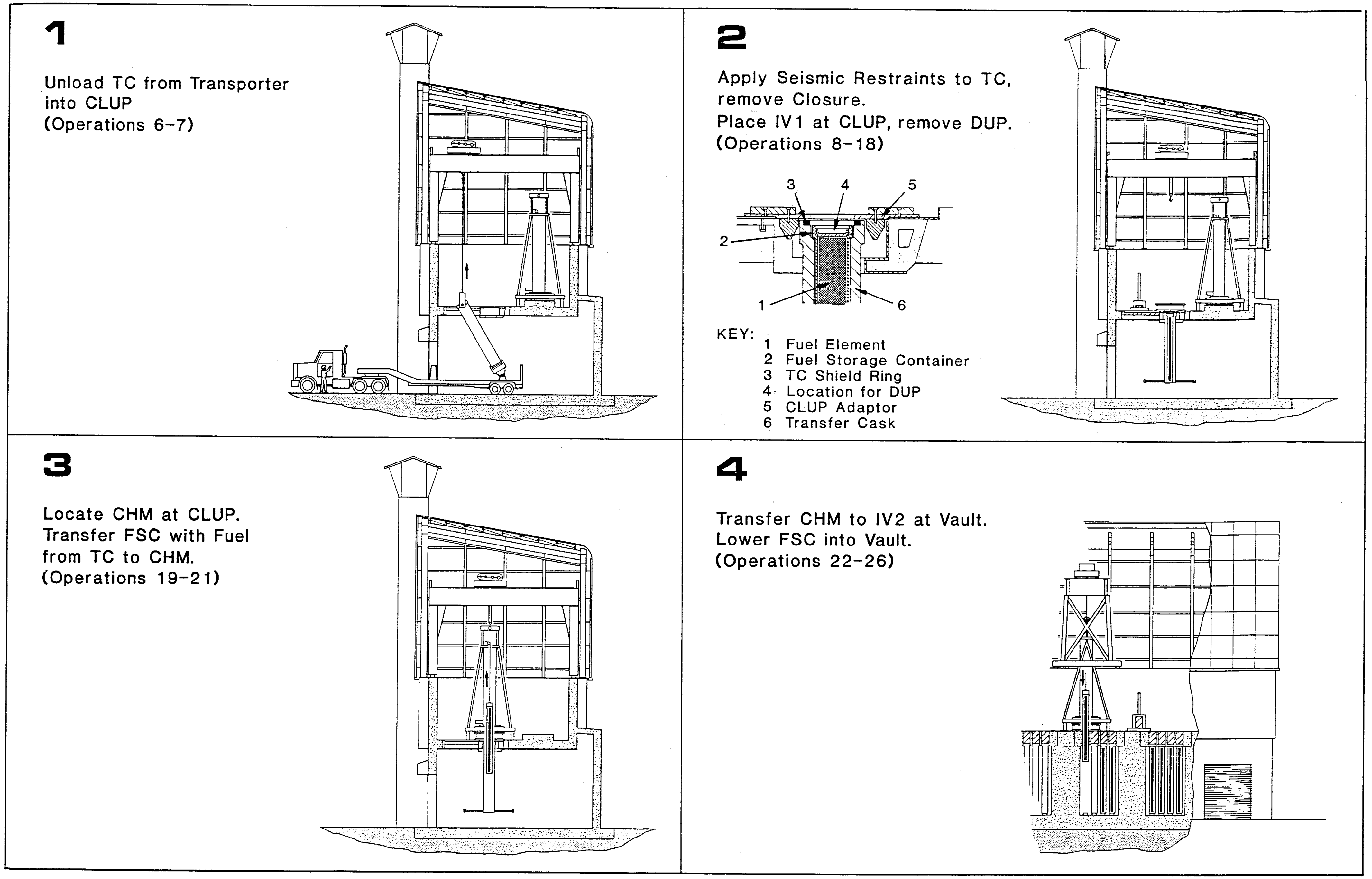

Figure 5.1-1b. Operating Sequence Flow Sheet.

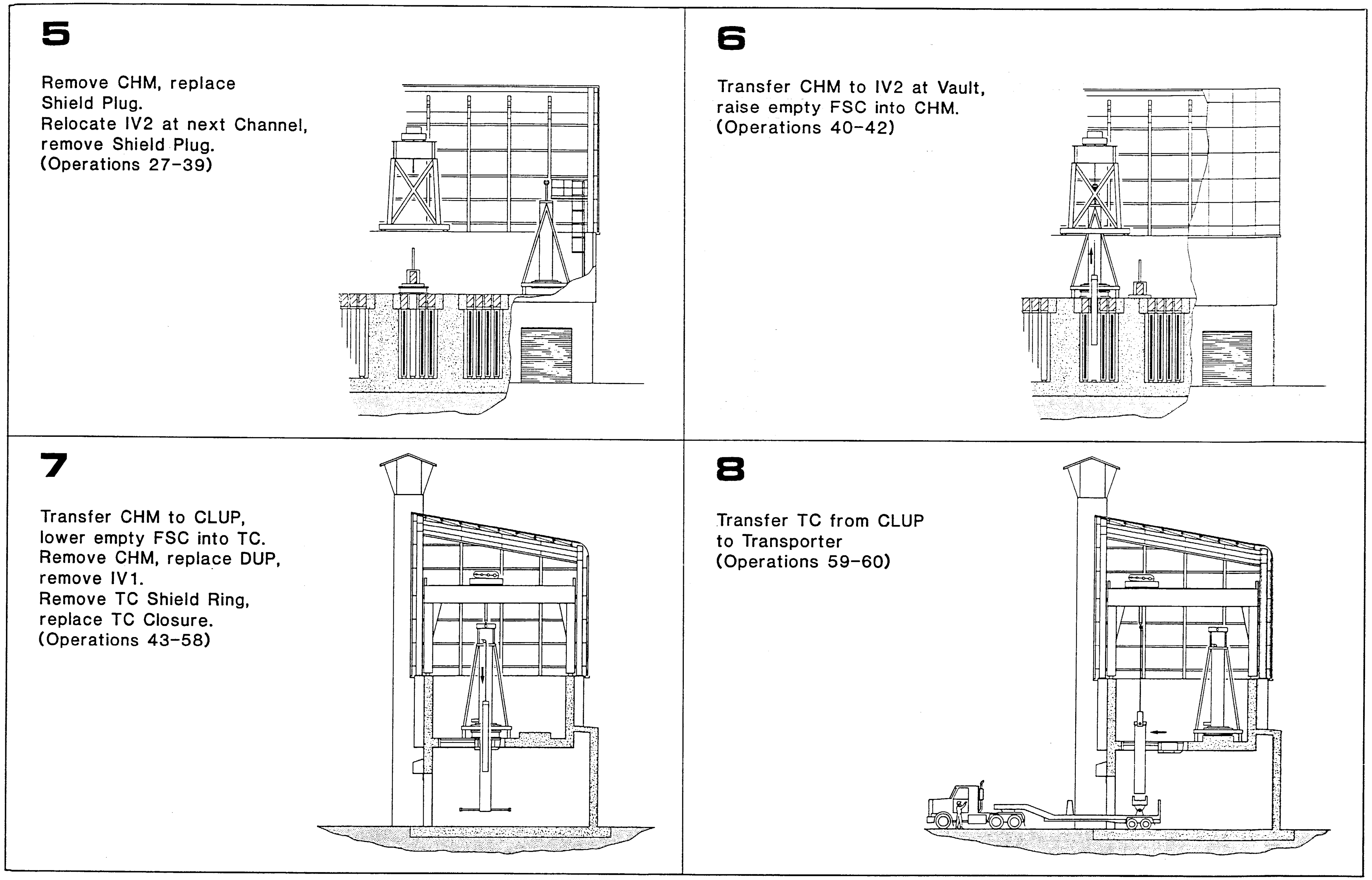

Figure 5.1-1c. Operating Sequence Flow Sheet.

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5.2. Controls

The CHM is operated from an on-board local control panel, and the MVDS crane is controlled by a pendant controller. The rest of the equipment at the MVDS does not require control stations. A pushbutton alarm bell is provided for warning prior to movement of the MVDS crane.

The control of the CHM is by a hardwired system consisting essentially of relays, contactors, lamps, limit switches and pushbuttons. The system is housed in a pair of cubicles mounted on the CHM itself, and is powered by a 480V/60Hz power source.

Electromechanical technology is used as far as possible as this represents the optimum balance between longevity, performance, reliability and cost.

Operation of the raise/lower mechanism is mechanically interlocked to the physical condition of the CHM by two keyswitches. The first prevents raise/lower mechanism operations if the isolation valves are not fully open, and prevents closing of the isolation valves unless the grapple and any item it may be handling are clear of the valve (i.e. at the upper datum position). The second prevents raise/lower mechanism operations when the mechanism handwind is in use.

The electrical equipment to be controlled consists of:

- Raise/lower mechanism motor
- Service brake
- Standby brake
- Grapple release solenoid.

5.2.1. Lamps

The following color coding is used for lamps:

White - normal operations

Yellow- off normal operations

Amber - fault conditions

All operations are considered normal (white lamps) except for the following:

Off normal (yellow lamp) operations

- Selection of grapple exchange mode

- Selection of individual fuel element grapple mode
- Selection of FSC mode without a FSC grapple fitted
- Selection of individual fuel element mode without an individual fuel element grapple fitted
- Selection of grapple exchange mode without being at the CLUP
- Installation of an individual fuel element grapple
- Main contactor not pulled in
- Standby brake manually released
- Lower datum

Fault (amber lamp) conditions

- Raise/lower mechanism motor overtemperature
- Raise/lower mechanism motor overtorque
- Grapple at Upper Ultimate Limit
- Grapple at Lower Ultimate Limit
- Chain broken
- Seismic tremor
- Raise overload
- Lower overload.

5.2.2. Load Sensing System

The load sensing system consists of two load cells positioned underneath the equalizer assembly on the fixed end of the chains. Associated with each load cell there are four trip levels, two of which are overload trips, the other two are underload trips; the appropriate overload and underload trip levels are selected according to which type of grapple is in use, the condition of the grapple jaws and the position of the grapple within the CHM.

In order to set up the load trip levels, two displays are provided internal to the control cubicles giving the load readout from each load cell individually. These two readouts are electrically summed to give a readout of the total load on the front panel.

When an overload condition is detected, raising operations are prevented, the overload lamp is illuminated, and the audible alarm is sounded. When an underload condition occurs lowering operations are prevented, the underload lamp is illuminated, and the audible alarm is sounded. In each case the service and standby brakes also are applied. The audible alarm may be canceled by pressing the adjacent load alarm accept pushbutton.

5.2.3. Lamp Test

There is a lamp test that applies power to all lamps on the front panel when the lamp test pushbutton is depressed. A lamp is adjacent to the lamp test pushbutton, and it lights only when the lamp test pushbutton is depressed.

5.2.4. Mode Select

The CHM mode is selectable by a three position keyswitch that locks in each position by a solenoid. The key is removable in each position. The mode select keyswitch determines the position of the grapple release band and the lower datum for each of the three distinct operating conditions of the CHM.

The mode may only be changed when the CHM is positioned at the CLUP with the grapple at upper datum and the jaws locked in the disengaged position. The mode keyswitch pushbutton must then be depressed, energizing the solenoid and thus unlocking the keyswitch.

A mode select error lamp lights if: 1) FSC mode is selected without a FSC grapple fitted or; 2) individual fuel element mode is selected without an individual fuel element grapple fitted or; 3) grapple exchange mode is selected when not at the CLUP.

During normal operations, the FSC handling position is selected and the key is removed.

5.2.5. Isolation Valves

The isolation valve interlock keyswitch is a two position keyswitch which is locked in the key inserted position by a solenoid.

Operation of the CHM is not permitted unless the isolation valves are locked in the open position and the isolation valve key is removed from the valve and inserted into the isolation valve interlock keyswitch on the control panel.

Two lamps on the control panel indicate when the valves are in the open or closed positions. These are for information only and are not used in the control circuitry.

5.2.6. Container Handling Machine Location

There is an indicator on the control panel of the position of the CHM, either at the CLUP or at the vault (i.e. not at the CLUP).

5.2.7. Raise/Lower Mechanism Operation

Raise/lower mechanism operation is controlled by two latching demand pushbuttons (one for raise and one for lower), and a stop pushbutton to cancel the raise or lower demand. Two position indications are provided, one for upper datum and one for lower datum. The actual position of lower datum is determined by the mode.

In normal operation when mechanism lower is demanded, the mechanism will be lowered until the grapple jaws unlocked signal is received, this signal being backed up by the lower datum signal. Similarly, when mechanism raise is demanded, the mechanism will be raised until the upper datum signal is received, this signal being backed up by the ultimate upper limit switch.

5.2.8. Grapples

There are two types of grapples which may be used in conjunction with the CHM: a FSC grapple to handle FSCs and an individual fuel element grapple to handle individual fuel elements. An indication of which type of grapple is fitted is provided on the control panel showing that either a FSC grapple is fitted, or an individual fuel element grapple is fitted. If neither type of grapple is fitted, then no indication is given.

An indication also is provided to show that the grapple is within the grapple release band, the position of which is determined by the mode.

Once the loaded grapple has entered the grapple release band, on further lowering the jaws become mechanically unlocked. The locked/unlocked condition of the jaws is indicated by two lamps on the control panel.

With the grapple jaws in the unlocked state, they may be actuated from the engaged to disengaged state by depressing the disengage pushbutton. The condition of the jaws is indicated by two lamps on the control panel (engaged or disengaged).

When the disengage pushbutton is depressed, the disengage lamp is illuminated until either the jaws become disengaged (engaged lamp extinguished, disengaged lamp illuminated, disengage lamp extinguished) or the duty cycle circuitry times it out (engaged lamp remains illuminated, disengage lamp extinguished).

Once the unloaded grapple has entered the grapple release band, on further lowering the jaws become mechanically unlocked and the jaws automatically engage. The locked/unlocked and disengaged/engaged condition of the jaws is indicated by lamps on the control panel (locked lamp extinguished, unlocked lamp illuminated, disengaged lamp extinguished, engaged lamp illuminated).

Once a loaded or unloaded grapple is raised from its seated condition in the grapple release band the jaws automatically mechanically lock, the state of the jaws remain locked until the grapple re-enters the grapple release band.

5.2.9. Trip Circuits

The following trip conditions cause the power to the raise/lower mechanism motor to be interrupted and cause the service and standby brakes to be applied immediately:

- Ultimate upper limit
- Raise/lower mechanism motor overtorque
- Chain broken.

The following trip conditions cause the power to the raise/lower mechanism motor to be interrupted, cause the service and standby brakes to be applied immediately and prevent the grapple jaws from being disengaged:

- Emergency stop
- Seismic tremor
- Three phase supply over voltage
- Three phase supply under voltage
- Three phase supply phase imbalance
- Lower ultimate limit
- Raise/lower mechanism motor over temperature.

Once the cause of the trip has been cleared, the reset pushbutton may be pressed to pull in the tripped contactors. Pressing the reset pushbutton before the relevant trip conditions have been cleared will not pull in the contactors.

The emergency stop pushbutton is of the key released type.

An indication is given of the state of the main contactor, and bears the legend 'Power,' indicating when power is applied to the motor, brake and grapple solenoid circuits.

5.2.10. Container Handling Machine Alarms

1. Standby brake released - The standby brake is manually released when handwinding the raise/lower mechanism. A warning lamp illuminates if the brake is left released.

2. Mode select error - The actual grapple fitted is detected by links and these are compared with the selected operating mode. If these disagree operations are inhibited.

3. Overload - Load exceeding 1700 lbs (or 6400 lbs with full FSC grapple). Note that there are two load cells, each sensing 50% of the load; the trip level is thus 850 lbs (or 3200 lbs) each.

4. Underload - Load under 374 lbs (or 1800 lbs with a full FSC grapple). The trip level is thus 187 lbs (900 lbs with a full FSC grapple).

5. Upper ultimate limit - Raise overtravel. Must be handwound off.

6. Lower ultimate limit - Lower overtravel. Must be handwound off.

7. Over-torque - High torque on the raise/lower mechanism (either of two detectors).

8. Over-temperature - Thermostat fitted to raise/lower mechanism motor.

9. Chain broken - Either of the two lifting chains broken.

10. Seismic tremor - Excessive vibration detected by a proprietary seismic tremor switch.

11. Thermal overload - Conventional thermal overload in the raise/lower motor circuit.

12. Under volts - A phase balance detector on the incoming mains supply monitors for imbalance or low voltage.

13. Over volts - Over voltage protection is provided by means of an overvoltage trip relay.

5.3. Spent Fuel Management Program

This section of the SAR comprises DOE's Spent Fuel Management Program document for the FSV ISFSI.

The Spent Fuel Management Program reflects how the fuel elements are stored in the ISFSI. Each fuel element has a unique serial number stamped on it. This serial number was visually verified with the fuel handling machine camera system and recorded prior to placing the fuel elements into the FSC. The Spent Fuel Management Program includes spent fuel records which identify the exact location of each fuel element at the MVDS and the amount of special nuclear material contained in each fuel element. A Tamper Indication Device (TID) has been placed between each shield plug and the charge face structure.

DOE's Spent Fuel Management Program is implemented through contractor procedures for the following activities:

Records showing the receipt, inventory and location, disposal, acquisition, and transfer of all spent fuel in storage are kept in accordance with 10 CFR 72.72(a).

A physical inventory of all the spent fuel in storage is conducted every 12 months in accordance with 10 CFR 72.72(b). A copy of each inventory is retained as a record until license termination.

Written material control and accounting procedures that are sufficient to enable accounting for material in storage are established, maintained, and followed in accordance with 10 CFR 72.72(c) and are maintained until license termination.

Records of spent fuel in storage are kept in duplicate and in separate locations in accordance with 10 CFR 72.72(d).

Accidental criticality events and any loss of special nuclear material are reported in accordance with 10 CFR 72.74 and the Emergency Response Plan.

A material status report is completed in computer-readable format, in accordance with NUREG/BR-0007 (Ref. 3) and NMMSS Report D-24 (Ref. 4). This report will be submitted within 60 days of the beginning of the physical inventory required by § 72.72(b) in accordance with 10 CFR 72.76(a) unless otherwise directed by the NRC.

Computer-readable Nuclear Material Transaction Reports are completed in accordance with 10 CFR 72.78(a), NUREG/BR-0006 (Ref. 5), and NMMSS Report D-24 whenever spent fuel is either transferred or received.

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5.4. Spent Fuel Transport

The spent fuel elements were transported to the MVDS using a transfer cask mounted on a trailer and pulled with a tractor. The spent fuel elements will be transported from the MVDS using an NRC licensed shipping cask.

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5.5. References

1. Fort St. Vrain MVDS Interlock Schedule 362F0027

2. PSC letter dated August 19, 1996 (P-96071), Crawford to Travers; Subject: "NRC Bulletin 96-04."

3. NUREG/BR-0007, Instructions for Completing Material Balance Report, Physical Inventory Listing, and Concise Note Forms

4. USNRC Nuclear Material Management and Safeguards System, Report D-24, Personal Computer Data

5. NUREG/BR-0006, Instructions for Completing Nuclear Material Transaction Reports

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