Document ID: TSR-103
Revision ID: 0
Effective Date: April 18, 2001

TECHNICAL SAFETY REQUIREMENTS

NEW WASTE CALCINING FACILITY

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U.S. Department of Energy
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Form 412.14
10/05/99
Rev. 02

REVISION LOG

Rev.	Date	Affected Pages	Revision Description
0	4/01	All	R. M. Stallman, Letter to Arthur Clark, "DOE Approval of TSR-103 (INTEC-WP-00-45)," dated February 5, 2001.

CONTENTS

ACRONYMS

AC	administrative control
DCS	distributed control system
DOE	U.S. Department of Energy
HEPA	high efficiency particulate air (filter)
HLLWE	High-Level Liquid Waste Evaporator
ICPP	Idaho Chemical Processing Plant
INTEC	Idaho Nuclear Technology and Engineering Center
LCO	limiting condition for operation
LCS	limiting control setting
LEL	lower explosive limit
LFL	lower flammability limit
NWCF	New Waste Calcining Facility
SAR	safety analysis report
SL	safety limit
SR	surveillance requirement
SSC	structure, system, and component
TBP	tributyl phosphate
TC	thermocouple
TSR	technical safety requirement

1. USE AND APPLICATION

1.1 Introduction

The U.S. Department of Energy (DOE) Order 5480.22, "Technical Safety Requirements,"[1] requires that DOE nuclear facilities prepare and implement technical safety requirements (TSRs). TSRs are those requirements that define the conditions, safe boundaries, and the management or administrative controls (ACs) necessary to ensure the safe operation of a nuclear facility and to reduce the potential risk to the public and workers from uncontrolled releases of radioactive or hazardous materials or from radiation exposures due to inadvertent criticality.

This section of the "Facility-Specific Technical Safety Requirements," of the Idaho Nuclear Technology and Engineering Center (INTEC) Technical Safety Requirements Document covers facility-specific TSRs for the New Waste Calcining Facility (NWCF). These TSRs are derived from the NWCF safety analysis.[2]

1.2 Definitions

For a complete list of definitions, see the INTEC TSR Document, "General Technical Safety Requirements."[3]

1.3 Logic Connectors

Logic connectors are used in TSRs to discriminate between and connect discrete conditions, actions, completion times, required surveillance, and required frequencies. For a complete discussion on logic connectors, see the INTEC Technical Safety Requirements Document. The logic connectors used in the tables presented throughout this document appear for emphasis in underscored uppercase type.

1.4 Operational Modes

Calciner-specific operational modes are defined below:

MODE		DEFINITION
Operation	-	The mission of the calciner, that of converting liquid waste feed to a more stable granular form, is being performed, i.e., fuel is flowing to the calciner.
Standby	-	The liquid waste feed is shut off, the calciner bed is fluidized the fuel is shut off.
Shutdown	-	The mission of the calciner is not being performed, i.e., fuel, liquid waste feed, and fluidizing air are shut off to the calciner.

High-Level Liquid Waste Evaporator (HLLWE) specific operational modes are defined below:

MODE		DEFINITION
Operation	-	The mission of the HLLWE, that of concentrating liquid, is being performed, i.e., steam is flowing to the reboiler.
Shutdown	-	The mission of the HLLWE is not being performed, i.e., steam flow is shut off to the reboiler.

1.5 Completion Times

The completion time allowed for a required action is referenced to the time of discovery (not to the time of occurrence) of a situation such as having inoperable equipment or variables not within limits. Equipment or variables outside specified limits require entering a condition, unless otherwise specified, provided that a facility is in a mode or condition that is specified in the applicability of limiting control settings (LCSs) or limiting conditions for operation (LCOs). Required actions must be completed prior to the expiration of the specified completion time. The condition remains in effect until the condition no longer exists or a facility is not within LCS or LCO applicability. For a complete discussion on completion times, see the INTEC TSR Document.

1.6 Frequency Notation

Each surveillance requirement (SR) has a specified frequency in which the surveillance must be met to meet the associated LCS or LCO. An understanding of the correct application of the specified frequency is necessary for compliance with the SR. The frequencies and allowable extensions are shown in Table 1-1.

Table 1-1. Frequency, notation, definition, and extensions.

Notation	Frequency	With 25% Extension
Each 8-hour shift	At least once every 8 hours	10 hours
Each 12-hour shift	At least once every 12 hours	15 hours
Daily	At least once every 24 hours	30 hours
Weekly	At least once every 7 days	9 days
Monthly	At least once every 30 days	38 days
Quarterly	At least once every 90 days	113 days
Semi-annually	At least once every 180 days	225 days
Annually	At least once every 365 days	456 days
Campaign	Prior to each campaign startup	NA
Restart	Prior to each restart	NA

1.7 Safety Limits

Safety Limits (SLs) are limits on process variables associated with physical barriers, generally passive, that are necessary for the intended INTEC facility operation. SLs are required to guard against an uncontrolled release of radioactive or hazardous material that results in significant consequences to the public. Thresholds that determine whether SLs are required are included in Chapter 5 , "Derivation of Technical Safety Requirements," in the facility-specific SAR.[4] For a complete discussion on SLs, see the INTEC TSR Document.

1.8 Limiting Control Settings

LCSs are safety system settings that control process variables to prevent exceeding SLs. LCSs are required to support SLs and need to be developed only when SLs are identified. For a complete discussion on LCSs, see the INTEC TSR Document.

1.9 Limiting Conditions For Operation

LCOs are the lowest (minimum acceptable) functional capability or performance level of safety structures, systems, and components (SSCs) and their support systems required for normal safe operation of an INTEC facility. For a complete discussion on LCOs, see the INTEC TSR Document.

1.10 Surveillance Requirement

SRs are the requirements relating to testing, calibration, or inspection. These requirements ensure that the necessary operability and quality of safety SSCs and their support systems required for safe operation of an INTEC facility are maintained. For a complete discussion on SRs, see the INTEC TSR Document.

2. NWCF SAFETY LIMITS

There are no SLs for the NWCF.

3/4. LIMITING CONTROL SETTINGS, LIMITING CONDITIONS FOR OPERATION, AND SURVEILLANCE REQUIREMENTS

There are no LCSs for the NWCF.

LCO 3.103.1 HLLWE TEMPERATURE LIMIT

A. The bulk solution temperature in the HLLWE shall not exceed 117°C.

B. At least two of the flash-column temperature instruments with automatic high temperature shutdown, T150-1C, -2C, -3C, -4C, -5C, -6C, -7C, -8C, -9C, or -10C, shall be operable.

APPLICABILITY: During the HLLWE operation mode.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Temperature instrument T150-1C, -2C, -3C, -4C, -5C, -6C, -7C, -8C, -9C, or -10C indicates greater than 117°C.	A. Shut a valve to terminate steam flow to the reboiler.	15 minutes
B. Fewer than two flash-column temperature instruments, which include T150-1C, -2C, -3C, -4C, -5C, -6C, -7C, -8C, -9C, and -10C, are operable.	B. Shut a valve to terminate steam flow to the reboiler.	15 minutes

SURVEILLANCE REQUIREMENTS

SURVEILLANCE FOR COMPLIANCE WITH LCO 3.103.1		FREQUENCY
SR 4.103.1.1	Operability checks of temperature instruments T150-1C, -2C, -3C, -4C, -5C, -6C, -7C, -8C, -9C, and -10C shall be made.	Each 12-hour shift
SR 4.103.1.2	The automatic shutdown feature on high temperature shall be tested and proved operable.	Annually or prior to startup
SR 4.103.1.3	Flash-column temperature instruments T150-1C, -2C, -3C, -4C, -5C, -6C, -7C, -8C, -9C, and -10C that are used for process operation shall be calibrated.	Annually or prior to startup

LCO 3.103.2 CALCINER BED TEMPERATURE LIMIT

A. The calciner bed temperature shall be greater than or equal to 340°C prior to initiating and during the flow of kerosene to the calciner.

B. The calciner bed temperature shall be greater than or equal to 420°C prior to initiating and during the flow of solvent to the calciner.

C. At least two thermocouples (TCs) with automatic low temperature shutdown in temperature rake instrument T105-1C shall be operable.

APPLICABILITY: During calciner operation and standby modes.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Temperature instrument T105-1C indicates lower than 340°C.	A. Close at least two manual valves in the path between each fuel nozzle and the kerosene tanks.	4 hours (unless automatic shutdown fails, then 10 minutes)
B. Temperature instrument T105-1C indicates lower than 420°C.	B. Close at least two manual valves in the path between fuel nozzle #3 and the solvent tanks.	4 hours (unless automatic shutdown fails, then 10 minutes)
C. Fewer than two TCs in temperature rake T105-1C are operable.	C. Close at least two manual valves in the path between each fuel nozzle and the kerosene and solvent tanks.	4 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE FOR COMPLIANCE WITH LCO 3.103.2		FREQUENCY
SR 4.103.2.1	An operability check of temperature rake instrument T105-1C shall be made.	Each 12-hour shift
SR 4.103.2.2	The automatic shutdown feature on low temperature shall be tested and proved operable.	During initial operation of each fuel nozzle and annually thereafter
SR 4.103.2.3	The temperature rake T105-1C shall be calibrated.	Prior to startup and annually thereafter

LCO 3.103.3 OXYGEN-TO-FUEL RATIO

A. When fuel is flowing to the calciner vessel, the oxygen-to-fuel flow ratio for each of the operating calciner fuel nozzles shall be greater than or equal to 1077.

APPLICABILITY: During the calciner operation mode.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A1. Instruments FF105-10C thru -13C indicate less than 1077 for more than 2 minutes	A1. Close at least two manual valves in the path between the affected fuel nozzle and the fuel tank.	A1. 4 hours (unless automatic shutdown fails, then 10 minutes)
<u>OR</u>		
A2. Instruments FF105-10C thru -13C are inoperable.	A2. Return instruments FF105-10C thru -13C to operability or begin shutdown of the affected fuel nozzle	A2. 10 minutes

SURVEILLANCE REQUIREMENTS

SURVEILLANCE FOR COMPLIANCE WITH LCO 3.103.3		FREQUENCY
SR 4.103.3.1	An operability check of the oxygen-to-fuel ratio instruments, FF105-10C thru -13C, shall be made.	Each 12-hour shift
SR 4.103.3.2	Instruments FF105-10C thru -13C shall be calibrated.	Prior to startup and annually thereafter
SR 4.103.3.3	The automatic shutdown feature on the low oxygen-to-fuel ratio shall be tested and proved operable.	During initial operation of each fuel nozzle and annually thereafter

LCO 3.103.4 FLUIDIZING AIRFLOW LIMITS

A. The fluidizing airflow shall be greater than or equal to 125 scfm when fuel is flowing to the calciner vessel.

APPLICABILITY: During the calciner operation mode.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Fluidizing airflow instrument F205-1C (or backup FISL-NC-205-1) indicates less than 125 scfm.	A. Close at least two manual valves in the path between each fuel nozzle and the kerosene and solvent tanks.	4 hours (unless automatic shutdown fails, then 10 minutes)
B. Fluidizing airflow instrument F205-1C is inoperable.	B. Use FISL-NC-205-1 as a temporary backup and monitor continuously.	10 minutes
C. Fluidizing airflow instrument F205-1C is inoperable AND Fluidizing airflow instrument FISL-NC-205-1 is inoperable.	C. Close at least two manual valves in the path between each fuel nozzle and the kerosene and the solvent tanks.	4 hours (unless automatic shutdown fails, then 10 minutes)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE FOR COMPLIANCE WITH LCO 3.103.4		FREQUENCY
SR 4.103.4.1	An operability check of fluidizing air flowrate instrument F205-1C shall be made.	Each 12-hour shift
SR 4.103.4.2	The automatic shutdown feature for low fluidizing airflow shall be tested and proved operable.	During initial operation of each fuel nozzle and annually thereafter
SR 4.103.4.3	The fluidizing airflow instrument in use shall be calibrated.	Prior to startup and annually thereafter

LCO 3.103.5 HYDROCARBON VAPOR CONCENTRATION LIMIT

A. The hydrocarbon vapor concentration shall be less than 60% of the lower explosive limit (LEL) / lower flammability limit (LFL) or the calciner cell airflow shall be greater than 1000 scfm.

B. The fuel flow shall be less than 11.4 gph to each nozzle.

APPLICABILITY: During the calciner operation and standby modes.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. The explosimeter (A2214-1C) indicates greater than or equal to 60% of the LEL/LFL AND The calciner cell ventilation flow (F2214-1C) indicates less than 1000 scfm for more than 1 minute.	A. Close at least two manual valves in the path between each fuel nozzle and the kerosene and solvent tanks.	10 minutes
B1. Fuel flow instrument F105-6C, -7C, (-8C or -37C as appropriate), or -9C indicates greater than 11.4 gph OR B2. Fuel flow instrument F105-6C, -7C, (-8C or -37C as appropriate), or -9C is inoperable.	B1. Close at least two manual valves in the path between the affected fuel nozzles and the kerosene and solvent tanks. B2. Restore instruments F105-6C, -7C, (-8C or -37C as appropriate), or -9C to operability or perform required action for B1.	B1. 4 hours (unless automatic shutdown fails, then 10 minutes) B2. 10 minutes
C. A2214-1C is inoperable AND F2214-1C is inoperable.	Close at least two manual valves in the path between each fuel nozzle and the kerosene and solvent tanks.	10 minutes
D. F2214-1C indicates less than 1000 scfm for more than 15 minutes AND A2214-1C is inoperable.	Close at least two manual valves in the path between each fuel nozzle and the kerosene and solvent tanks.	10 minutes

CONDITION	REQUIRED ACTION	COMPLETION TIME
E. F2214-1C is inoperable AND A2214-1C indicates more than or equal to 60% of the LEL/LFL for more than 1 minute.	Close at least two manual valves in the path between each fuel nozzle and the kerosene and solvent tanks.	10 minutes

SURVEILLANCE REQUIREMENTS

SURVEILLANCE FOR COMPLIANCE WITH LCO 3.103.5		FREQUENCY
SR 4.103.5.1	An operability check of explosimeter A2214-1C or calciner cell ventilation flow instrument F2214-1C shall be made.	Each 12-hour shift
SR 4.103.5.2	An operability check of fuel flow instrument F105-6C, -7C, (-8C or -37C as appropriate), and -9C shall be made.	Each 12-hour shift
SR 4.103.5.3	Explosimeter A2214-1C or calciner cell ventilation flow instrument F2214-1C shall be calibrated.	Prior to startup and annually thereafter
SR 4.103.5.4	Fuel flow instruments F105-6C, -7C, (-8C or -37C as appropriate), and -9C shall be calibrated.	Prior to startup and annually thereafter
SR 4.103.5.5	The automatic shutdown feature on high fuel flow shall be tested and proved operable for each nozzle.	During initial operation of each nozzle and annually thereafter

5. NWCF ADMINISTRATIVE CONTROLS

AC 5.103.1 STAFFING REQUIREMENTS

A minimum of one certified operator shall be present in the control room and responsible for safe shutdown of the HLLWE and the calciner. This staffing requirement is not applicable during control room evacuation or during emergency shutdown activities.

6. REFERENCES

1. U.S. Department of Energy Order 5480.22, "Technical Safety Requirements," September 15, 1992.

2. Idaho Nuclear Technology and Engineering Center Safety Analysis Report, *Facility-Specific Safety Analyses*, SAR-103, "New Waste Calcining Facility."

3. Idaho Nuclear Technology and Engineering Center Safety Technical Safety Requirements Document, *General Technical Safety Requirements*.

4. Idaho Nuclear Technology and Engineering Center Safety Analysis Report, *Facility-Specific Safety Analysis*, SAR-103, "New Waste Calcining Facility," Chapter 5, "Derivation of Technical Safety Requirements."

APPENDIX A

Bases

1. PURPOSE

The technical safety requirement (TSR) bases show how the numeric values, conditions, surveillance, and action statements fulfill the purpose derived from the safety documents. The primary purpose for describing the basis of each requirement is to ensure that any future changes to the requirement will not affect its original intent or purpose. This appendix contains the basis information for the limiting conditions for operation (LCOs), surveillance requirements (SRs) and administrative controls (ACs).

2. BASES

INTEC Safety Limits

There are no SLs for operation of the NWCF.

INTEC Limiting Control Settings

There are no LCSs for operation of the NWCF.

INTEC Limiting Conditions for Operations

LCO 3.103.1

The HLLWE concentrates aqueous waste. Although unlikely, organic liquids might be inadvertently transferred to the HLLWE along with aqueous solutions containing concentrated nitric acid (HNO_3). Tributyl phosphate (TBP), Amsco, n-dodecane, and hexone were routinely used in the extraction processes.

Much of the aqueous waste in the Tank Farm has been in contact with an organic phase at some time. The presence of trace quantities of organics in the aqueous phase is expected. Organics dissolved in the aqueous phase are not capable of significant nitrated-organic reactions. A separate organic layer is necessary for a self-accelerating nitrated-organic reaction to occur.

TBP-HNO_3 systems can form explosive nitrate complexes if the right conditions of temperature, nitric acid concentration, TBP concentration, and vessel geometry are present. If an explosion were to occur, contamination could be released to the atmosphere above normal operating levels and worker fatalities could result from the explosion. Therefore, the maximum allowable temperature is specified to prevent a nitrated-organic explosion.

Laboratory experiments with TBP-HNO_3 complexes[1] indicate that a reaction with 10.7 M nitric acid can occur at 130°C under the most favorable conditions.[2] The LCO for the HLLWE is set at 117°C. If the HLLWE solution were to reach a temperature of 117°C, the operator would have time to respond and shut off the steam to the evaporator to prevent reaching a temperature of 130°C.

Because the LCO is set 13° below the 130°C limit, an instrument error of 8° is allowed, leaving a margin of an additional 5° to allow time for the operator to manually shut down the evaporator if the automatic shutdown fails.[3,4] The 117°C limit is only an upper limit. The evaporator will normally be operated between 95° and 108°C.

The temperature of the evaporator is measured by a redundant thermocouple fail-safe system and recorded continuously by the distributed control system (DCS). If any temperature reaches or exceeds 117°C, an alarm sounds, and steam to the evaporator is shut off automatically. When the steam is shut off, the evaporator process temperature begins to drop immediately.

The evaporator high-temperature automatic shutdown feature shall be tested and proved operable annually, or prior to HLLWE startup. Operability checks of the temperature instruments shall be made once a shift. Operability check criteria are defined in operating procedures. The evaporator temperature instruments shall be calibrated annually or prior to the next startup to ensure their accuracy. If the evaporator temperature exceeds limits or if fewer than two temperature instruments are operable, steam flow to the evaporator shall be shut off within 15 minutes. Experimental studies have shown that the effect of evaporation can take up the chemical heat of a nitrated-organic reaction for at least 30 minutes.[5,6]

Annually is defined in Table 1-1 as at least once every 365 days with a 25% extension to 456 days. The provisions of the extension are not intended to be used repeatedly as an operational convenience to extend surveillance intervals. A surveillance performed after the 25% extension is an SR violation. Regular usage of the 25% extension may lead to enforcement action.

LCO 3.103.2

The calciner is operated at a nominal bed temperature of 500° to 600°C. Immediately upon entry to the calciner vessel, autoignition of the fuel prevents accumulation of explosive concentrations of fuel vapor within the vessel. If an explosion were to occur, radioactivity could be released to the environment and worker fatalities could result from the explosion. Autoignition is ensured at bed temperatures equal to or greater than 340°C for kerosene and 420°C for solvent. Studies indicate that autoignition of the kerosene will occur down to a bed temperature of 310° to 325°C, depending on the chemical composition of the bed.[7,8,9,10] To provide a safety margin, kerosene flow to the calciner fuel nozzles is terminated automatically before the bed temperature drops to below 340°C, which is above the autoignition temperature of kerosene. Similarly, solvent has an autoignition temperature of 400°C. Solvent-flow shutdown occurs automatically at a calciner bed temperature of 420°C.[11] Flow to each fuel nozzle is automatically terminated by the rapid shutdown system, which causes two valves to be closed in each fuel line. The additional requirement of two manual block valves to be closed in each fuel path to a fuel nozzle provides assurance that kerosene will not enter the calciner vessel when the bed temperature is lower than 340°C. The requirement also provides assurance that solvent will not enter the calciner vessel when the bed temperature is lower than 420°C. If the automatic shutdown works, the manual valves must be closed within 4 hours. If the automatic shutdown feature fails, the manual valves must be closed within 10 minutes. This poses no undue risk because shutdown setpoints are higher than the actual autoignition temperatures, and a rapid drop of the bed temperature is very unlikely. This requirement is implemented by operating procedures.

An operability check of temperature rake T105-1C shall be made once a shift. The calciner automatic low temperature shutdown feature is tested and proved operable during initial operation of each fuel nozzle during startup of calcining operations and annually thereafter. This automatic shutdown feature cannot be tested until the calciner is in the operation mode, because fuel must be flowing to complete this verification. The automatic shutdown feature verification is not required when recovering from a process upset. Operability check criteria are defined in operating procedures. The calciner temperature instruments shall be calibrated prior to startup of calcining operations and annually thereafter to ensure their accuracy.

Annually is defined in Table 1-1 as at least once every 365 days with a 25% extension to 456 days. The provisions of the extension are not intended to be used repeatedly as an operational convenience to extend surveillance intervals. A surveillance performed after the 25% extension is an SR violation. Regular usage of the 25% extension may lead to enforcement action.

LCO 3.103.3

The in-bed combustion of kerosene provides the heat necessary for the calcination process. One of the four fuel nozzles (Nozzle No.3) has the capability of burning either first-cycle waste solvent (C_{10}-C_{14} hydrocarbons, TBP, and dodecane) or kerosene, but not a mixture of both fuels. Flow instrument F105-8C is used to monitor kerosene flow and F105-37C is used to monitor solvent flow for Nozzle No. 3. The valves in the fuel path not being used are maintained in the closed position. An abundant supply of oxygen is mixed with kerosene and solvent in the fuel nozzles to reduce the chance of leaving unburned hydrocarbons in the system, which could result in an in-vessel explosion. By maintaining an adequate oxygen-to-fuel volume ratio provides protection against conditions that could lead to an explosion, a possible release of radioactive contamination to the environment, and worker fatalities.

During normal operation, oxygen enters the calciner vessel through the fuel nozzle as an atomizing gas. Additional oxygen in the fluidizing air enters the bottom of the calciner vessel after passing through the distribution plate. Pilot plant studies[7] indicate that the atomizing oxygen should be supplied at about 85% of the theoretical amount required for complete combustion of hydrocarbon fuel to CO_2 and H_2O. If the ratio of the oxygen flow to the fuel flow to a given nozzle is maintained above 898, which corresponds to 56% of the stoichiometric amount, assuming only the minimum fluidizing airflow of 117 scfm, then an ample supply of oxygen is present for stable combustion. These stoichiometry calculations assume a conservatively high specific gravity of 0.82 for fuel and a C-H ratio characteristic of $C_{10}H_{22}$. Fuel and air nozzle combustion studies have shown that the unburned hydrocarbon content of the combustion products increases substantially as the O_2 flow is decreased to below 50% of the stoichiometric amount.[12] The LCO for the oxygen-to-fuel ratio is set at 1077 to keep the O_2 flow more than 54% of the stoichiometric amount, even if no O_2 from the fluidizing air participates in the combustion.

Normal operating oxygen-to-fuel ratios are maintained at approximately 1940. During startup and possibly at other times, transient conditions can occur that momentarily yield ratios of 1077 or smaller. The transients are inconsequential and should not result in a shutdown of fuel and oxygen flow to a given nozzle.

After activation of an automatic shutdown, the manual fuel supply valves must be closed within 4 hours. If the automatic shutdown fails, the manual valves must be closed within 10 minutes. The calciner automatic low oxygen-to-fuel shutdown feature is tested and proved operable during initial operation of each fuel nozzle during the startup of calcining operations and annually thereafter. This automatic shutdown feature cannot be tested until the calciner is in the operation mode, because fuel must be flowing to complete this verification. The automatic shutdown feature verification is not required when recovering from a process upset. An operability check of the oxygen-to-fuel ratio instruments shall be made once a shift. Operability check criteria are defined in operating procedures. The oxygen-to-fuel ratio instruments shall be calibrated prior to the startup of calcining operations and annually thereafter to ensure their accuracy.

Annually is defined in Table 1-1 as at least once every 365 days with a 25% extension to 456 days. The provisions of the extension are not intended to be used repeatedly as an operational convenience to extend surveillance intervals. A surveillance performed after the 25% extension is an SR violation. Regular usage of the 25% extension may lead to enforcement action.

LCO 3.103.4

As fluidizing airflow to the calciner vessel decreases, the probability for unburned fuel buildup within the calciner vessel increases,[7] particularly during startup. If sufficient fuel vapor were to collect in the vessel and other necessary conditions[8] were satisfied, an explosion could result. This could result in a radioactive release. To prevent this event, analysis has shown that at least 117 scfm of fluidizing air is required.[8] The LCO incorporates an adequate margin for measurement uncertainties, instrument response, and shutdown to prevent falling below 117 scfm.

After activation of an automatic shutdown, the manual valves must be closed within 4 hours. If the automatic shutdown fails, the manual fuel valves must be closed within 10 minutes. The calciner automatic low fluidizing airflow shutdown feature is tested and proved operable during initial operation of each fuel nozzle during startup of calcining operations and annually thereafter. The automatic shutdown feature verification is not required when recovering from a process upset. This automatic shutdown feature cannot be fully tested until the calciner is in the operation mode, because fuel must be flowing to complete the verification. This test is completed in two parts. The first part is completed prior to the startup of calcining operations, and the second part must be performed while fuel is flowing to the calciner vessel. The first part tests the DCS logic by simulating low fluidizing airflow and verifying that the rapid shutdown system sends a signal to close the required valves. The second part tests for positive fuel flow cutoff, by simulating a shutdown event and verifying valve closure. An operability check of the fluidizing airflow rate shall be made once a shift. Operability check criteria are defined in operating procedures. The calciner fluidizing airflow instrument that is in use shall be calibrated prior to the startup of calcining operations and annually thereafter, to ensure the instrument's accuracy.

Flow indicator FISL-NC-205-1 is used as a backup instrument to F205-1C. FISL-NC-205-1 is equipped with a local alarm and is continuously monitored by an operator any time that F205-1C is temporarily out of service.

Annually is defined in Table 1-1 as at least once every 365 days with a 25% extension to 456 days. The provisions of the extension are not intended to be used repeatedly as an operational convenience to extend surveillance intervals. A surveillance performed after the 25% extension is an SR violation. Regular usage of the 25% extension may lead to enforcement action.

LCO 3.103.5

A fuel vapor concentration greater than of 0.7 vol% must exist inside the calciner cell for an explosion to be possible. For this to happen, two abnormal conditions must be satisfied: (1) fuel must be leaking in the calciner cell and (2) the cell ventilation flow rate must be low enough for the vapor concentration to exceed 0.7 vol%.

The possibility of an undetected fuel leak into the calciner cell is unlikely. There is one 1/4-inch stainless steel line carrying fuel to each of the four fuel nozzles. All of the joints on these lines are welded except where they are joined to the fuel loops and fuel nozzles using mechanical connections. After each startup and routinely during calciner operation, the lines and connections are visually inspected from the calciner cell viewing windows to ensure that there are no fuel leaks. In the event of a major fuel leak, there would be an abnormally high fuel flow through that line, which would be detected by fuel-flow instrumentation. The fuel flow would be shut down at 11.4 gph, therefore, this case is the maximum credible leak.

The normal ventilation flow rate in the calciner cell is 2530 acfm. If a fuel leak of 11.4 gph were to occur (fuel density 6.7 lb/gal and molecular weight of 142 lb/lbmole), a fuel vapor concentration of 0.18 vol%, which is below the explosive limit, could result.[13]

If two of the three exhaust blowers should fail, the calciner cell ventilation flow rate would drop to about 1260 acfm. If a fuel leak of 11.4 gph occurred, a fuel vapor concentration of 0.35 vol% could result.[13] To cause the calciner cell ventilation rate to drop below 1000 scfm, the three exhaust blowers must fail, the calciner cell exhaust dampers must be closed, or the cell inlet high efficiency particulate air (HEPA) filters must be overloaded with particulate. These conditions are not probable, and the chance of one occurring precisely when fuel is leaking into the calciner cell is remote.

The calciner cell ventilation rate is continuously monitored by flow indicator F2214-1C on the DCS. This flow indicator has a LO flow warning at 2000 scfm and a LOLO flow alarm at 1000 scfm.

The second initiating condition is an adequate supply of oxygen to support the explosion. Because the calciner cell is not purged with an inert gas, the oxygen in the ventilation air is considered to satisfy this condition.

The third initiating condition requires the presence of an ignition source to initiate the explosion. Two situations have been identified. The first postulates that a drop of fuel comes into contact with a portion of the calciner vessel that is hot enough to cause the fuel to burn. The second situation considers the possibility of an electrical impact wrench that produces a spark during a remote handling operation.

The fourth initiating condition requires that no action is initiated to stop the fuel leak or to correct the calciner cell ventilation system failure. This requires that the certified operator in the control room ignore process changes and process alarms for a minimum of 20 minutes. During this 20-minute period, fuel leaking into the calciner cell at 30 gph is instantly vaporized and reaches the hydrocarbon vapor concentration of 0.7 vol%. If only one fuel line is leaking, 80 minutes would be required to obtain 0.7 vol%. Significant fuel leaks in the four fuel lines would trigger four high fuel flow alarms (F105-6C through -9C or F105-37C). This decreased fuel flow in the calciner vessel would cause a decrease in vessel temperature and cause

T105-1C to alarm. The vaporized fuel would cause the explosimeter to alarm when the fuel vapor concentration exceeded 0.42 vol%, or 60% of the lower explosive limit/lower flammability limit.[14]

This National Fire Protection Association Standard 69 requires that combustible concentrations be maintained at or below 25% of the LFL. The maximum credible leak of 11.4 gph would result in a kerosene vapor concentration of 25% of the LFL. An exception to the 25% limit is allowed when there is automatic instrumentation with safety interlocks. Then, the combustible concentration is allowed to be maintained at or less than 60% of LFL. The 11.4 gph limit involves an automatic shutdown of a safety system. The 0.42 vol% setting for the explosimeter is 60% of the 0.7 vol% LEL/LFL.

An explosimeter operates by drawing a representative sample of the cell air across a detector located in the calciner exhaust air duct. With this type of instrument, receiving spurious alarms is not unusual. Therefore, it is necessary to verify the validity of each alarm. This is accomplished by checking the sample flow rotameter to verify adequate sample flow to the detector.

After activation of an automatic shutdown, the manual fuel supply valves must be closed within 4 hours. If the automatic shutdown fails, the manual valves must be closed within 10 minutes. At a calciner cell ventilation flowrate of 1200 scfm which is half of the normal ventilation flowrate and the normal maximum operating fuel flowrate of 30 gph it would take at least 60 minutes to achieve a 0.7 vol% hydrocarbon vapor concentration. Therefore, allowing 10 minutes to manually shut the fuel off is a conservative time limit. An operability check of the explosimeter and the calciner cell ventilation flow and fuel flow instrumentation shall be made once each shift. Operability check criteria are defined in operating procedures. The calciner cell explosimeter, the fuel flow and cell ventilation flow instruments shall be calibrated prior to the startup of calcining operations and annually thereafter, to ensure their accuracy. The automatic shutdown feature on high fuel flow shall be tested and proved operable for each fuel nozzle during the initial operation of each fuel nozzle during the startup of calcining operations and annually thereafter. This automatic shutdown feature cannot be tested until the calciner is in the operation mode, because fuel must be flowing to complete this verification. The automatic shutdown feature verification is not required when recovering from a process upset.

Annually is defined in Table 1-1 as at least once every 365 days with a 25% extension to 456 days. The provisions of the extension are not intended to be used repeatedly as an operational convenience to extend surveillance intervals. A surveillance performed after the 25% extension is an SR violation. Regular usage of the 25% extension may lead to enforcement action.

AC 5.103.1

This staffing requirement specifies the minimum number of certified personnel required to safely shutdown the HLLWE and the calciner processes. Procedures define the minimum staffing requirements for operations of the HLLWE and the calciner. During control room evacuation, the control room operator is allowed to leave the control room. During emergency shutdown activities, the control room operator is allowed to leave the control room to enact the manual shutdown procedures.

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