ISSUED BY
RPP-WTP PDC

R11169345

System Logic Description for High-Level Waste Facility - Melter Process (HMP) System

Document title: System Logic Description for High-Level Waste Facility - Melter Process (HMP) System

Document number: 24590-HLW-PER-J-04-0004, Rev 1

Contract number: DE-AC27-01RV14136

Department: Controls and Instrumentation

Author(s): Joe Horn

Checked by: Mark Friedrich

Issue status: Issued for Permitting Use

Approved by: Wayne Underhill

Approver's position: C&I Department

Approver's signature: _____ Signature 3/8/10 Date

River Protection Project
Waste Treatment Plant
2435 Stevens Center Place
Richland, WA 99354
United States of America
Tel: 509 371 2000

This bound document contains a total of 18 sheets

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

History Sheet

Rev	Reason for revision	Revised by
0	Issued For Permitting Use	A.L.Coulam
1	Revised to include changes to permitted instruments	J.J. Horn

Contents

Notice iii
History Sheet iv
Acronyms vi
Glossary 1
1 Introduction 2
2 Applicable Documents 2
3 Description 3
3.1 HMP-MLTR-00001 and HMP-MLTR-00002 3
3.2 HMP-BBLR-00006 and HMP-BBLR-00013 3
3.3 HOP-FCLR-00001 through HOP-FCLR-00004 4
3.4 HMP-ALFT-00001 through HMP-ALFT-00004 4

Tables

Table 1 Associated Instruments for HLW Melters 5

Figures

Figure 1 Typical Temperature Averaging of a Melter Plenum 8
Figure 2 Typical Glass Pool Level and Density 9
Figure 3 Typical Plenum Differential Pressure 10
Figure 4 Typical IR Cameras 11
Figure 5 Typical Air Lift Valves 12

Acronyms

ADS	air displacement slurry
AEA	Atomic Energy Act
DI	density indicator
DOE	US Department of Energy
DT	density transmitter
IHLW	immobilized high-level waste
IR	Infrared
HFP	HLW melter feed process system
HLW	high-level waste/ high-level waste vitrification facility
HMP	HLW melter process system
HOP	HLW offgas process system
LAH	level alarm high
LAHH	level alarm high high
LALL	level alarm low low
LE	level element
LI	level indicator
LSH	level switch high
LT	level transmitter
P&ID	piping and instrumentation diagram
PDAHH	pressure differential alarm high-high
PDI	pressure differential indicator
PDT	pressure differential transmitter
TALL	temperature alarm low low
TDAH	temperature differential alarm high
TE	temperature element
TI	temperature indicator
TT	temperature transmitter
YC	valve control
YV	on/off valve
WTP	Hanford Tank Waste Treatment and Immobilization Plant

Glossary

Control system	Refers to electronic processors that perform regulatory and logical control functions necessary for normal plant operation
High-high	Refers to a notification in the control system that is activated when the applicable variable reaches a point that is significantly higher than that expected during normal operation
Low-low	Refers to a notification in the control system that is activated when the applicable variable reaches a point that is significantly lower than that expected during normal operation

1 Introduction

This document describes the instrument control logic for the melter and ancillary equipment in the melter process (HMP) system within the high-level waste (HLW) facility associated with the dangerous waste permit.

2 Applicable Documents

24590-HLW-M6-HMP-00001	*P&ID - HLW MELTER 1 FEED AND AGITATION*
24590-HLW-M6-HMP-00002	*P&ID - HLW MELTER 1 SYSTEM FILM COOLER AND OFFGAS CONNECTION*
24590-HLW-M6-HMP-00003	*P&ID - HLW MELTER 1 REFRACTORY COOLING*
24590-HLW-M6-HMP-00004	*P&ID - HLW MELTER 1 ELECTRODES*
24590-HLW-M6-HMP-00005	*P&ID - HLW MELTER 1 STARTUP HEATERS*
24590-HLW-M6-HMP-00006	*P&ID - HLW MELTER 1 EAST DISCHARGE HEATERS AND AIRLIFT*
24590-HLW-M6-HMP-00007	*P&ID - HLW MELTER 1 WEST DISCHARGE HEATERS AND AIRLIFT*
24590-HLW-M6-HMP-00008	*P&ID - HLW MELTER 1 GLASS POUR MONITORING*
24590-HLW-M6-HMP-00012	*P&ID - HLW MELTER 1 FILM COOLER UTILITIES*
24590-HLW-M6-HMP-00013	*P&ID - HLW MELTER 1 PRESSURE, DENSITY AND LEVEL DETECTION*
24590-HLW-M6-HMP-00014	*P&ID - HLW MELTER 1 REFRACTORY COOLING*
24590-HLW-M6-HMP-20001	*P&ID - HLW MELTER 2 FEED AND AGITATION*
24590-HLW-M6-HMP-20002	*P&ID-HLW MELTER 2 FILM COOLER AND OFFGAS CONNECTION*
24590-HLW-M6-HMP-20003	*P&ID - HLW MELTER 2 REFRACTORY COOLING*
24590-HLW-M6-HMP-20004	*P&ID - HLW MELTER 2 ELECTRODES*
24590-HLW-M6-HMP-20005	*P&ID - HLW MELTER 2 STARTUP HEATERS*
24590-HLW-M6-HMP-20006	*P&ID - HLW MELTER 2 EAST DISCHARGE HEATERS AND AIRLIFT*
24590-HLW-M6-HMP-20007	*P&ID - HLW MELTER 2 WEST DISCHARGE HEATERS AND AIRLIFT*
24590-HLW-M6-HMP-20008	*P&ID - HLW MELTER 2 GLASS POUR MONITORING*
24590-HLW-M6-HMP-20012	*P&ID - HLW MELTER 2 FILM COOLER UTILITIES*
24590-HLW-M6-HMP-20013	*P&ID - HLW MELTER 2 SYSTEM PRESSURE, DENSITY AND LEVEL DETECTION*
24590-HLW-M6-HMP-20014	*P&ID - HLW MELTER 2 REFRACTORY COOLING*

3 Description

The HLW HMP system components and ancillary equipment that pertain to instrumentation and are included in the dangerous waste permit are the following:

HMP-MLTR-00001	HLW Melter 1
HMP-MLTR-00002	HLW Melter 2
HMP-BBLR-00006	Melter 1 Level Detector
HMP-BBLR-00013	Melter 2 Level Detector
HOP-FCLR-00001	Melter 1 Film Cooler
HOP-FCLR-00002	Melter 2 Film Cooler
HOP-FCLR-00003	Melter 1 Standby Offgas Insert
HOP-FCLR-00004	Melter 2 Standby Offgas Insert
HMP-ALFT-00001	Melter 1 Air Lift Lance
HMP-ALFT-00002	Melter 1 Air Lift Lance
HMP-ALFT-00003	Melter 2 Air Lift Lance
HMP-ALFT-00004	Melter 2 Air Lift Lance

3.1 HMP-MLTR-00001 and HMP-MLTR-00002

The high-level waste (HLW) melters receive a blend of HLW concentrate and glass former additives from the melter feed process (HFP) system. The melters are fed via air displacement slurry (ADS) pumps. The melters convert the feed into molten glass and deliver it to stainless steel canisters. The pour spout connects the melter discharge chamber to the HLW canister. After the glass is transferred into the canister, it cools to form a durable glass waste form. Immobilized high-level waste (IHLW) is the resulting product (glass plus canister).

The feed slurry is transferred using two feed pumps, each supplying a separate feed nozzle on the melter. The feed slurry will fall from the feed nozzles, which are located in the melter lid, onto the molten glass surface within the melter. The feed material will form a distinct layer, often referred to as the "cold cap," on the surface of the glass pool. This system is also equipped to flush the feed lines with demineralized water, to clean the feed lines and to establish the cold cap prior to transferring waste. This is referred to as melter pre-feeding.

The melters are equipped with several plenum thermocouples, used primarily to determine the coverage of the cold cap. The plenum temperatures are averaged to a single melter plenum temperature. If this temperature falls below acceptable limits pre-feeding to the melter will be terminated. See figure 1 for more details on melter plenum temperature.

3.2 HMP-BBLR-00006 and HMP-BBLR-00013

The melter glass level detector functions using three gas purged probes penetrating the glass pool to different depths. By measuring the differential pressure between each of the legs the density and level of the glass pool are calculated. If the level rises above acceptable limits the control system will alarm and terminate slurry feeding. Glass discharge will be terminated if the glass pool level falls below acceptable limits. Operators will be alerted to the low level condition. See figure 2 for details on melter level detection.

3.3 HOP-FCLR-00001 through HOP-FCLR-00004

During normal operation the melter generates steam, gases, aerosols, vapors, and particulates, which are handled by the offgas system, HOP. Each melter has two attached film coolers, a primary and a standby, which serve as the interface between the offgas systems and the melter. The primary film coolers are designed to cool the offgas below the glass sticking temperature to minimize solids deposition on the walls of offgas piping. The standby film coolers are used to supplement the primary film coolers if upset conditions are detected in the melter plenum. The offgas system is designed to maintain a vacuum in the melter plenum for containment of the offgases. This vacuum is measured and controlled in part by redundant differential pressure detectors between the melter plenum and the melter cave. If the melter plenum differential pressure rises above acceptable limits the control system will alarm the operator and take the following actions:

- Terminates slurry feeding
- Terminates pre-feeding
- Opens the standby offgas line
- Disables demineralized water to the film coolers
- Disables air supply to the film coolers

For more details on plenum differential pressure detection see figure 3.

3.4 HMP-ALFT-00001 through HMP-ALFT-00004

Each melter contains two identical, independently operated, discharge chambers located adjacent to each other on both melters. The glass is discharged by an airlift system which injects air into the discharge riser effectively raising the glass level in the riser. The glass will flow down a trough and through the discharge chamber and into the canisters for cooling, solidification, and storage. The glass level in the canister will be monitored by an IR camera and a thermal image of the canister will be displayed in the control room. Termination of a pour will generally be controlled by an operator based on this image. The control system will disable glass pouring from an airlift when any of the following occur:

- Glass pool level falls below acceptable limits
- IR camera thermal image analyzer detects a canister glass level above acceptable limits
- Lift is in progress in the neighboring chamber
- Canister is not in position to receive the waste glass
- Discharge chamber temperature is not in the appropriate range for glass pouring

For more details on the melter airlifts see figures 4 and 5.

Table 1 Associated Instruments for HLW Melters

P&ID	Monitoring or Control Parameter	Type of instrument/control device	Instrument/ control device tag number
24590-HLW-M6-HMP-00004	Melter 1 plenum temperature, 62"	Temperature Element Temperature Transmitter Temperature Indicator Temperature Element Temperature Transmitter Temperature Indicator	TE-0920A* TT-0920A* TI-0920A* Or TE-0920C* TT-0921A* TI-0920C*
24590-HLW-M6-HMP-00004	Melter 1 plenum temperature, 59"	Temperature Element Temperature Transmitter Temperature Indicator Temperature Element Temperature Transmitter Temperature Indicator	TE-0920B* TT-920A* TI-0920B* Or TE-920D* TT-0921A* TI-0920D*
24590-HLW-M6-HMP-20004	Melter 2 plenum temperature, 62"	Temperature Element Temperature Transmitter Temperature Indicator Temperature Element Temperature Transmitter Temperature Indicator	TE-2920A* TT-2920A* TI-2920A* Or TE-2920C* TT-2921A* TI-2920C*
24590-HLW-M6-HMP-20004	Melter 2 plenum temperature, 59"	Temperature Element Temperature Transmitter Temperature Indicator	TE-2920B* TT-2920A* TI-2920B*

			Or
		Temperature Element	TE-2920D*
		Temperature Transmitter	TT-2921A*
		Temperature Indicator	TI-2920D*
24590-HLW-M6-HMP-00013	Melter 1 glass pool density	Density Transmitter	DT-0132
		Density Indicator	DI-0132
24590-HLW-M6-HMP-00013	Melter 1 glass pool level	Level Transmitter	LT-0131
		Level Indicator	LI-0131
24590-HLW-M6-HMP-2013	Melter 2 glass pool density	Density Transmitter	DT-2132
		Density Indicator	DI-2132
24590-HLW-M6-HMP-20013	Melter 2 glass pool level	Level Transmitter	LT-2131
		Level Indicator	LI-2131
24590-HLW-M6-HMP-00013	Melter 1 plenum pressure	Pressure Differential Transmitter	PDT-0139A*
		Pressure Differential Indicator	PDI-0139A*
			Or
		Pressure Differential Transmitter	PDT-0139B*
		Pressure Differential Indicator	PDI-0139B*
24590-HLW-M6-HMP-20013	Melter 2 plenum pressure	Pressure Differential Transmitter	PDT-2139A*
		Pressure Differential Indicator	PDI-2139A*
			Or
		Pressure Differential Transmitter	PDT-2139B*
		Pressure Differential Indicator	PDI-2139B*

24590-HLW-M6-HMP-00008	Melter 1 West canister level	Level Element (IR Camera) Level Transmitter Level Indication	LE-0816 LT-0816 LI-0816B
24590-HLW-M6-HMP-00007	Melter 1 West Discharge Air Lift	Valve Control On/Off Valve	YC-0761 YV-0761
24590-HLW-M6-HMP-00008	Melter 1 East canister level	Level Element (IR Camera) Level Transmitter Level Indication	LE-0820 LT-0820 LI-0820B
24590-HLW-M6-HMP-00006	Melter 1 East Discharge Air Lift	Valve Control On/Off Valve	YC-0644 YV-0644
24590-HLW-M6-HMP-20008	Melter 2 West canister level	Level Element (IR Camera) Level Transmitter Level Indication	LE-2816 LT-2816 LI-2816B
24590-HLW-M6-HMP-20007	Melter 2 West Discharge Air Lift	Valve Control On/Off Valve	YC-2761 YV-2761
24590-HLW-M6-HMP-20008	Melter 2 East canister level	Level Element (IR Camera) Level Transmitter Level Indication	LE-2820 LT-2820 LI-2820B
24590-HLW-M6-HMP-20006	Melter 2East Discharge Air Lift	Valve Control On/Off Valve	YC-2664 YV-2664

*These instrument sets are duplicates. Only one instrument set is required to remain functioning during waste feed operations.

Figure 1 Typical Temperature Averaging of a Melter Plenum

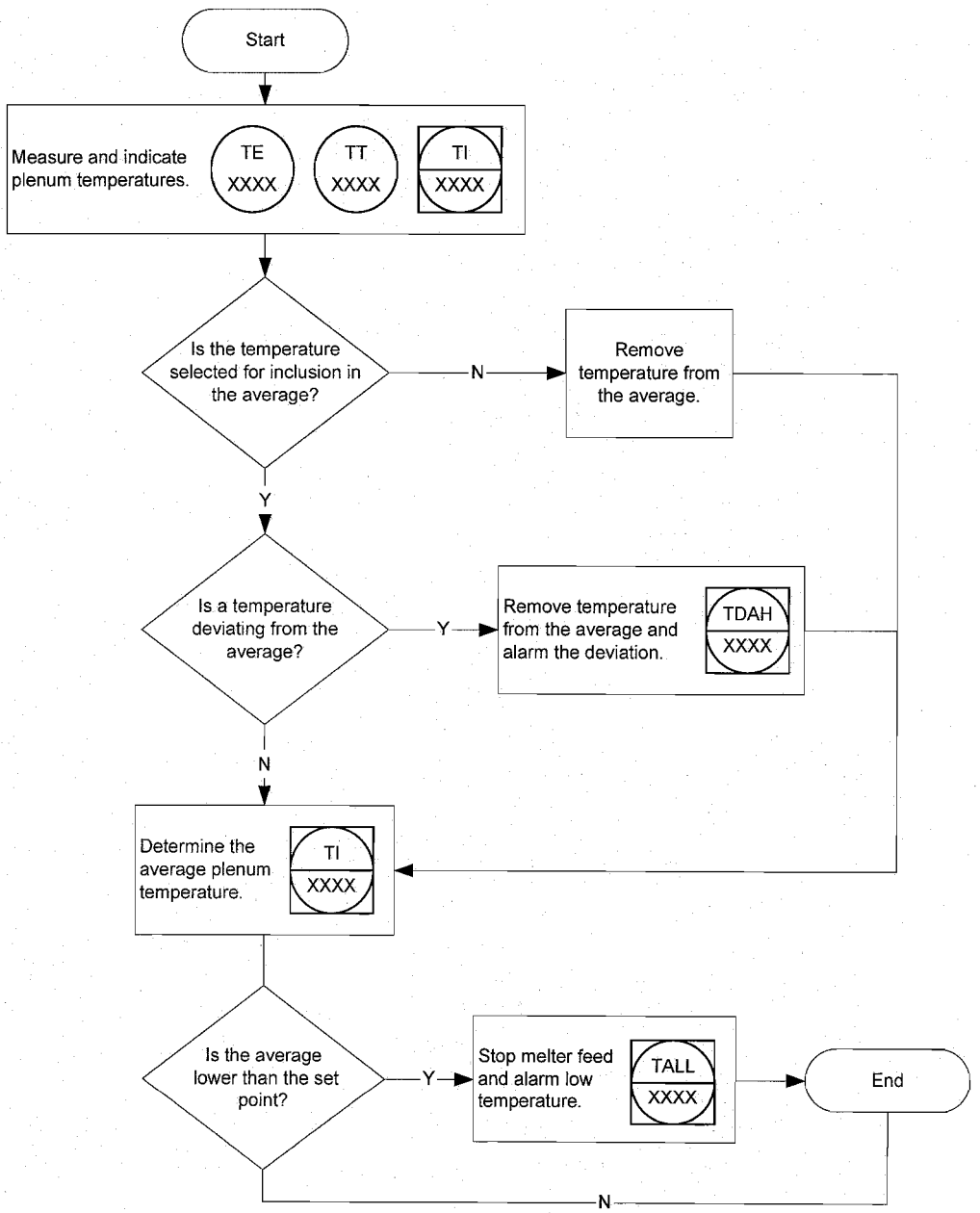

Figure 2 Typical Glass Pool Level and Density

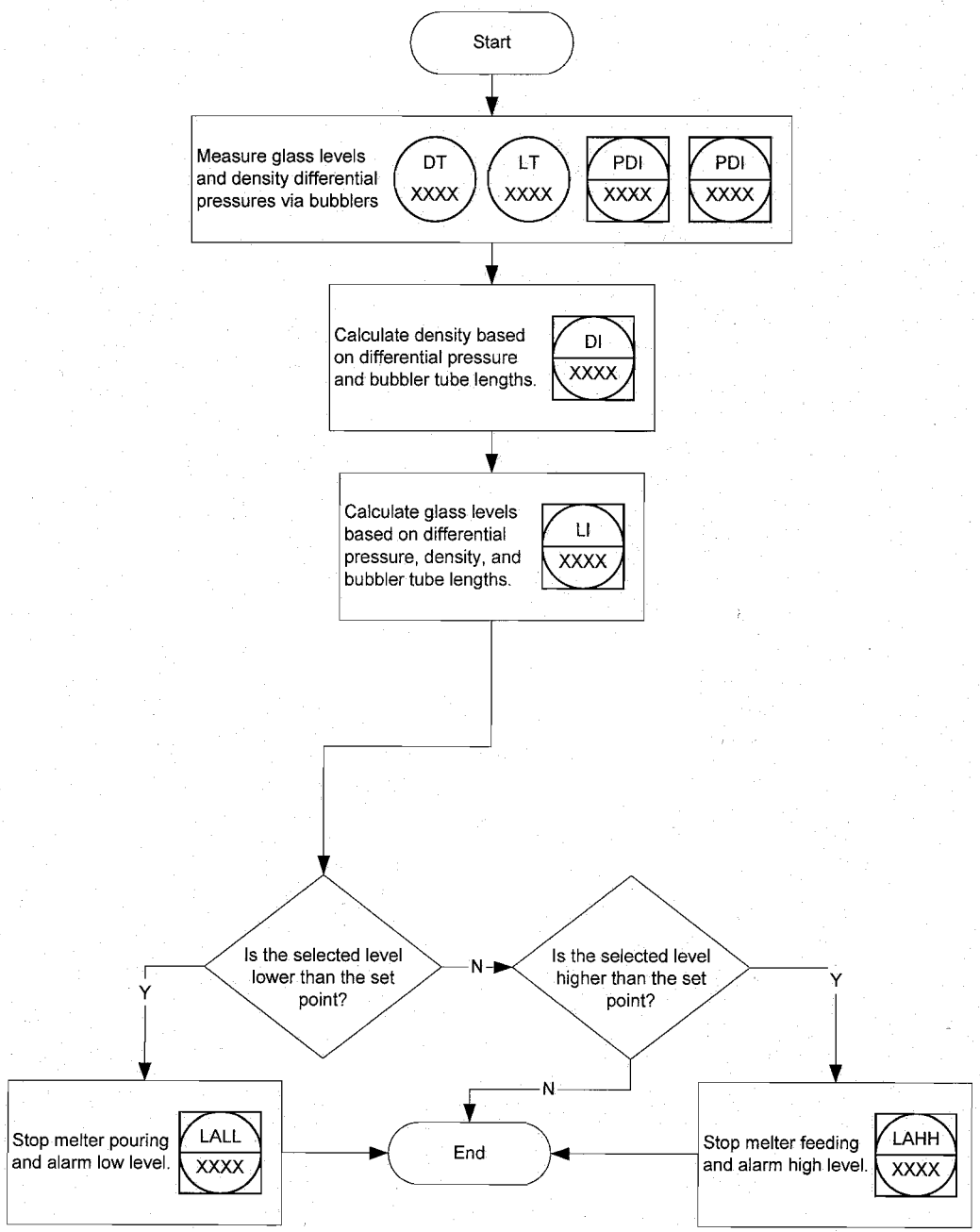

Figure 3 Typical Plenum Differential Pressure

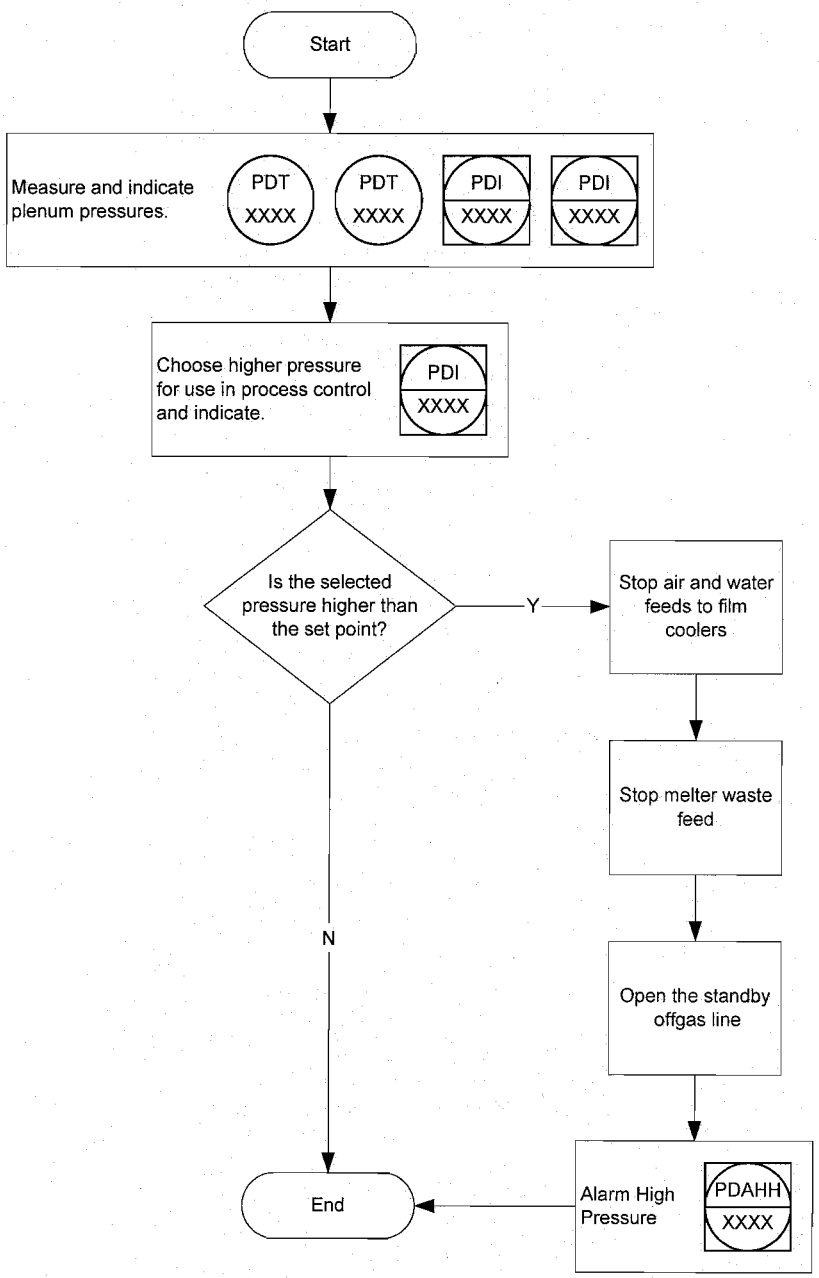

Figure 4 Typical IR Cameras

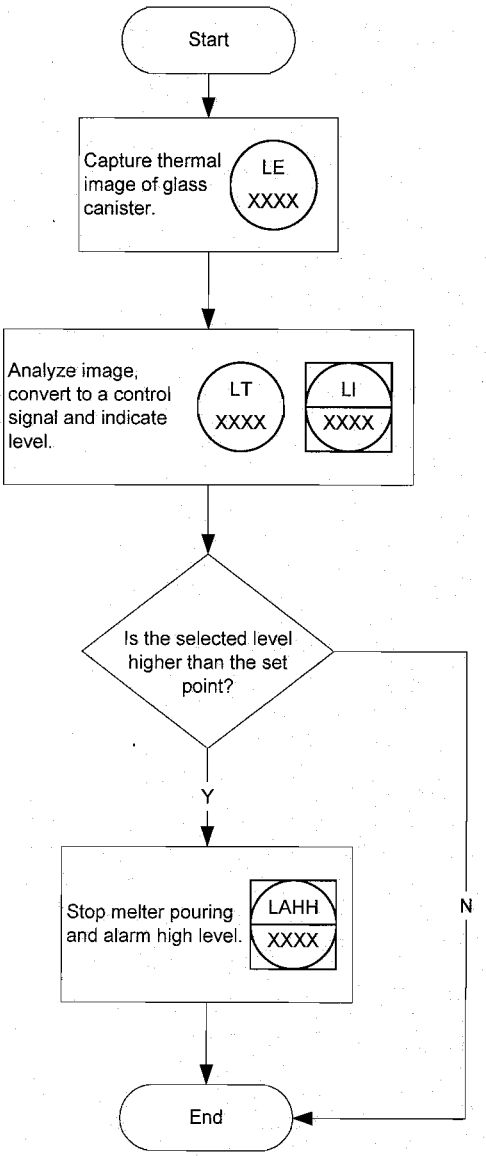
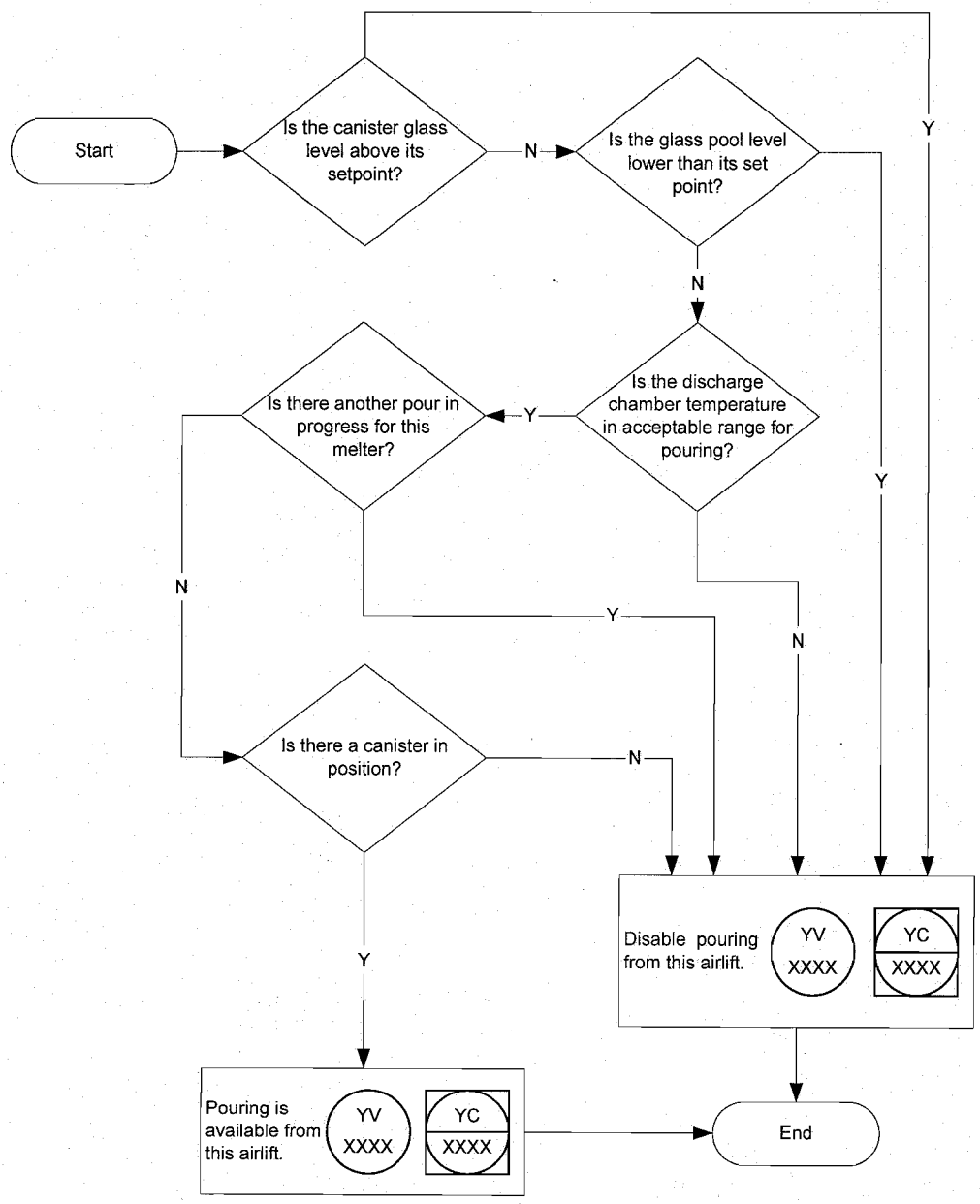
Figure 5 Typical Air Lift Valves