the valve extreme positions and should be operable in the control room. The valve may be automatic or remote manual, with actuation initiated by the control system automatically (automatic valve) or by the operator manually from the control room.

steam generator: the equipment that provides heat to turn feedwater into motive steam and also reheats the steam in a reheat cycle. In a conventional steam generator, the heat is produced by the burning of fuel (usually coal, oil, or gas). In an HRSG, the heat comes from the exhaust of an external heat source such as a gas turbine, sometimes supplemented by the burning of additional fuel in the gas turbine exhaust. Drum-type steam generators employ a large drum to separate steam from the water as it boils in the tubes. The drum accommodates the increase in volume resulting from the water's conversion to steam, which is then taken from the drum through a section of superheating tubes to obtain the temperature needed at the main turbine. In the once-through type of steam generator, which does not use a drum, the feedwater is converted to motive steam conditions as it passes directly through the tubes.

2.2.4 Control System

integrated control system (ICS): a control system featuring multiple processors, input/output (I/O) modules, and memory storage interconnected through a communication network and equipped with redundant power supplies. Normally, a distributed control system (DCS) or redundant programmable logic controllers (PLCs) will meet this requirement.

The minimum ICS features to meet the reliability and redundancy needs addressed in this Standard are as follows:

(a) dual processors

(b) uninterrupted power supply

(c) I/O associated with redundant plant equipment and instruments should not be connected to the same I/O cards

(d) outputs that fail to known position during processor or internal communication failure

local control system: a control system that allows control of the final control element from a location in the vicinity of the primary element or the final control element.

transmitter select: the ICS programming should be designed to handle instrument failures safely. The transmitter selection programming should follow a safe progression of selection steps in the event of failure of each transmitter as shown below. A failed transmitter or switch should produce a trip signal for the two-out-of-three trip logic.

The following examples illustrate this principle using high level conditions:

(a) Three-Transmitter Select (Example)

(1) zero transmitters failed (normal operation): median select of good signals.

(2) one transmitter failed: high select of remaining good signals (one of three trip signals).

(3) two transmitters failed: select remaining transmitter and two out of three protective trips.

(4) three transmitters failed: level controllers revert to manual and hold last good output.

(b) Two Transmitter Select With One Level Switch for Two-Out-of-Three Logic (Example)

(1) zero transmitters failed (normal operation): high select of two good signals.

(2) one transmitter failed: remaining good transmitter selected (one of three trip signals).

(3) one transmitter failed and high-level switch alarm: remaining good transmitter selected and two out of three protective trips.

(4) two transmitters failed: level controllers revert to manual, hold last good controller output, and two out of three protective trips.

2.3 Symbol Legend

See Table 1 for symbol legend to be used for reference to figures.

2.4 Device Identification Letters

See Table 2 for a list of device identification letters.

2.5 References

The following is a list of publications referenced in this Standard.

ANSI/ISA 5.1-1984 (R1992), Instrument Symbols and Identification

Publisher: Instrument Society of America (ISA), 67 Alexander Drive, Research Triangle Park, NC 27709

CS-2251, Recommended Guidelines for the Admission of High-Energy Fluids to Steam Surface Condensers

Publisher: Electric Power Research Institute (EPRI), 3420 Hillview Avenue, Palo Alto, CA 94304

Standards for Closed Feedwater Heaters, Fifth Edition (1992)

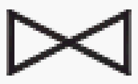
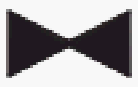
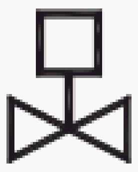
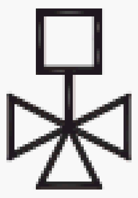
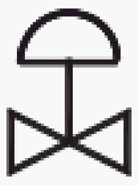
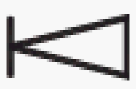
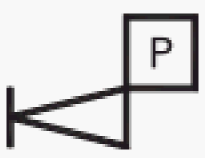
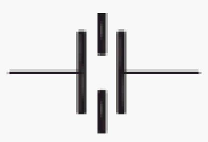
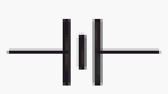
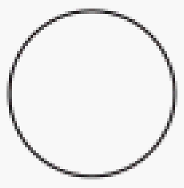
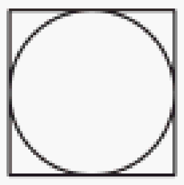
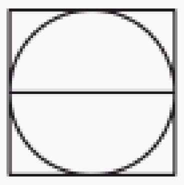
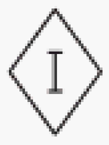
Standards for Steam Surface Condensers, Ninth Edition (1995 or latest edition)

Publisher: Heat Exchange Institute (HEI), 1300 Summer Avenue, Cleveland, OH 44115-2815

3 DESIGN RECOMMENDATIONS

This section outlines specific recommendations for the design of the systems listed. These recommendations are intended to represent a conservative design for protection from water induction. There is no intention to supersede any existing codes or governmental regulations.

Table 1 Symbol Legend

Symbol	Description
	Normally open valve
	Normally closed valve
	Open-shut power-operated valve
	Power-operated three-way valve
	Modulating control valve
	Check valve
	Power-assisted check valve
	Orifice
	Flow element
	Field mounted instrument
	Shared control, shared display function field mounted
	Shared control, shared display function normally accessible to the operator at primary panel (e.g., ICS)
	Hardware or software interlock

3.1 Steam Generators

3.1.1 It is the plant designer's responsibility to review and understand the design features of the steam generator and the user's responsibility to adhere to the operating procedures of the steam generator manufacturer as a precaution against water induction. The majority of the incidents of turbine water damage caused by water entering the turbine from the steam generator system have occurred during start-up or shutdown of a unit. The steam generator manufacturer's design and operating recommendations should include the measures required to prevent the induction of water into the motive steam piping. Such areas as superheater attemperators, boiler start-up systems, high drum levels, and undrained superheaters are potential sources of water.

3.1.2 Experience has shown that once-through flow units, because of their start-up system, hold a greater potential for water induction through the motive steam system during start-up and shutdown operating modes than do drum-type steam generators. It is recommended that the start-up system on once-through units be designed so that no single failure of equipment can result in water entering the motive steam line. Therefore, at least two [paras. 3.1.2(a) and (b), or (a) and (c)] of the following independent means of automatically preventing water from the start-up system from entering the motive steam lines should be provided:

(a) automatic opening of the drain system to the condenser from the start-up system flash tank, separator, or leveling vessel on detection of high level.

(b) automatic closing of the block valve in the line from the start-up system (flash tank or separator) to the motive steam system on detection of high-high level in the flash tank or separator. The superheater division valve should also be closed on high-high level.

(c) automatic block of all sources of water entering the start-up system by either tripping all feed pumps or closing the feedwater block valve in the supply line to the flash tank, separator, or leveling vessel on detection of high-high level in the flash tank or separator.

NOTE: These means of protection should be activated prior to turbine steam admission.

Typical start-up systems for once-through boilers are shown in Figs. 1, 2, and 3. Figure 1 shows the implementation of the three independent means of protection listed above for a flash tank or separator start-up system using a local control system. Figure 2 shows the same means of protection implemented using an integrated control system (ICS).

3.1.2.1 In some once-through units, the start-up system design has evolved to separate the functions of steam/water separation using steam separators and separate leveling vessels, drain tanks, or water collecting tanks. These once-through units may also use sliding pressure start-up and may not include steam path block valves. In this situation, level control of the leveling vessel should be maintained through controlled discharge to the condenser, which should be forced open upon high level in the leveling vessel. Any additional valving in the line to the condenser should also be forced open. If the level in the leveling vessel reaches a high-high level, a boiler-turbine trip should be initiated. A typical system using a leveling vessel and an integrated control system is shown in Fig. 3.

3.1.2.2 When used for turbine water induction protection, the drain line block valve, the feedwater block valve, the superheater division valve, and the flash tank steam outlet block valve should have indicators in the control room for the open and closed positions.

Table 2 Device Identification Letters

Letter	First Letter: Measured or Initiating Variable	Succeeding Letters: Readout or Passive Function	Output Function	Modifier
A	. . .	Alarm	. . .	. . .
C	. . .	. . .	Control	. . .
E	. . .	Sensor (primary element)	. . .	. . .
F	Flow rate	. . .	. . .	. . .
H	. . .	. . .	. . .	High
I	. . .	Indicate	. . .	. . .
L	Level	. . .	. . .	Low
P	Pressure	. . .	. . .	. . .
S	. . .	. . .	Switch	. . .
T	Temperature	. . .	Transmit	. . .
Z	Position	. . .	. . .	. . .

Fig. 1 Typical Flash Tank/Separators Arrangement: Local Control System

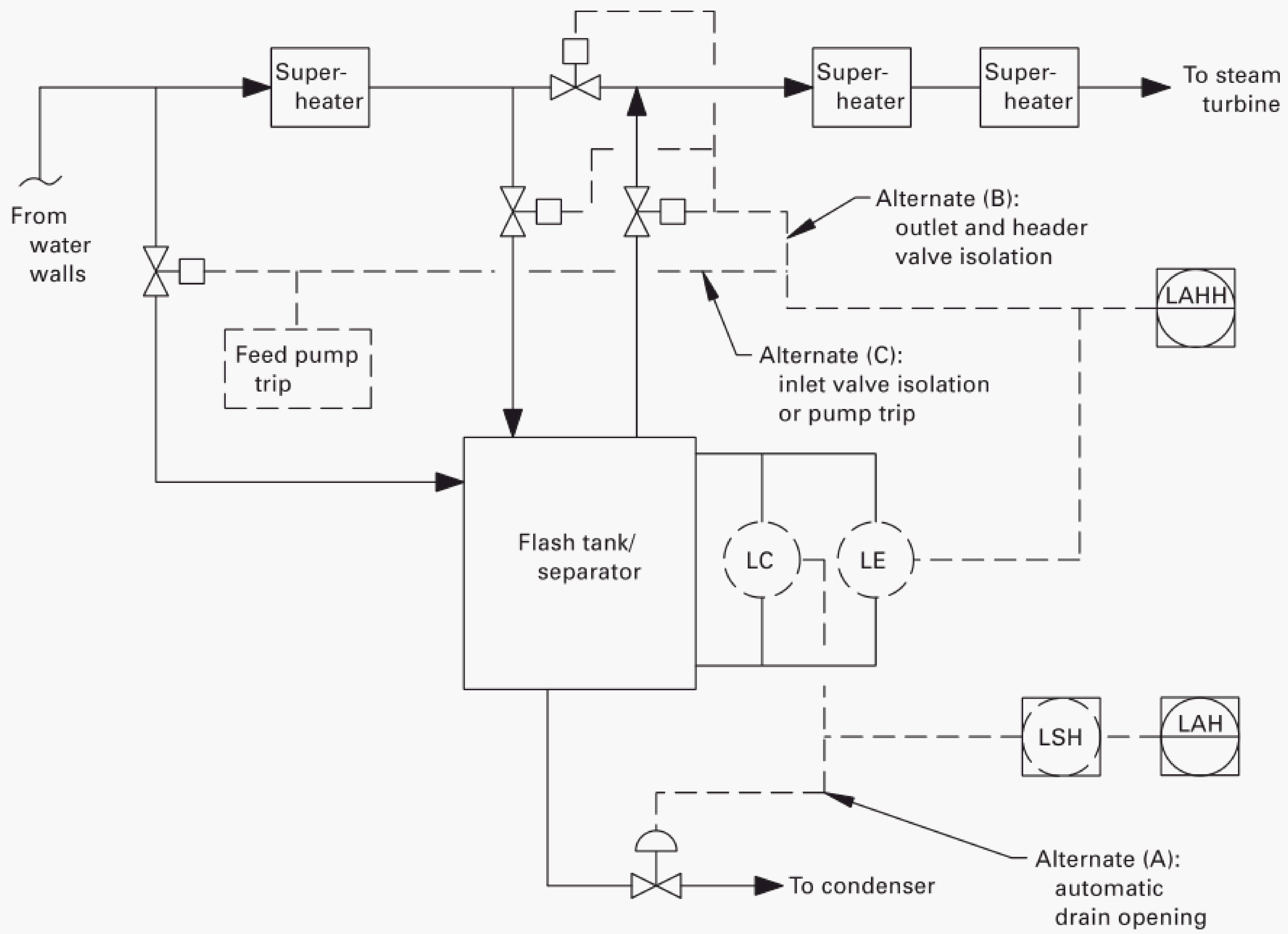
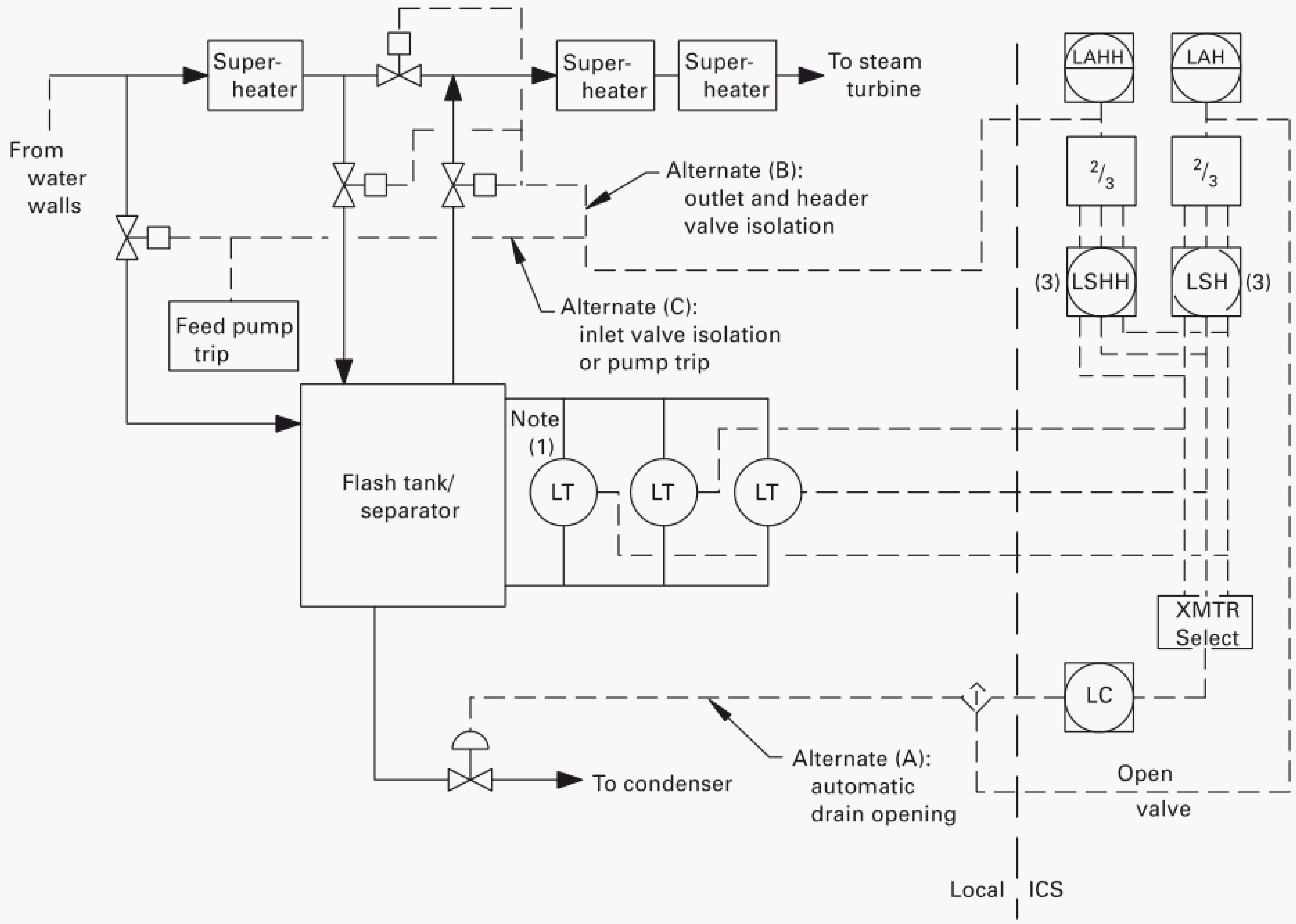


Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

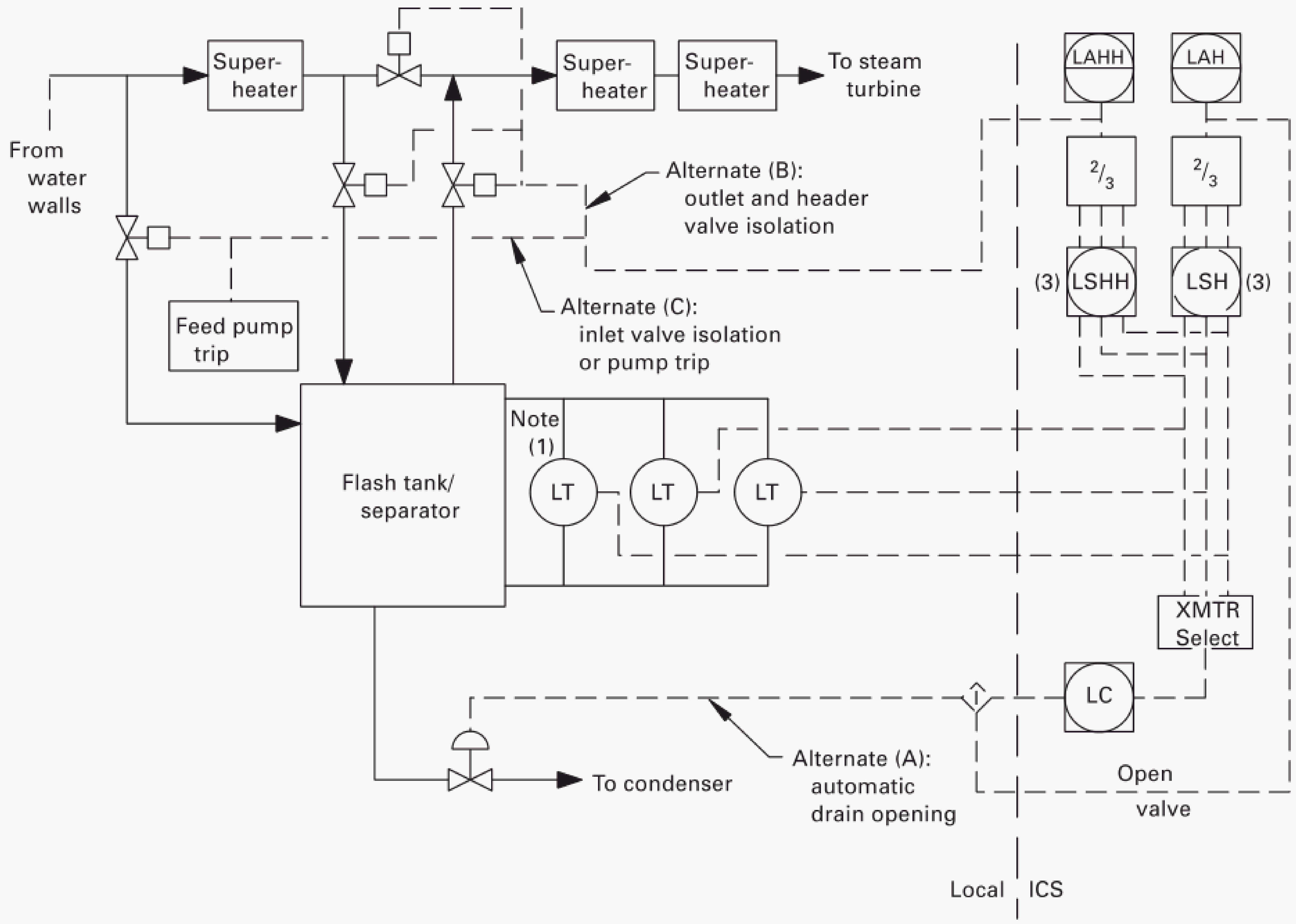
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

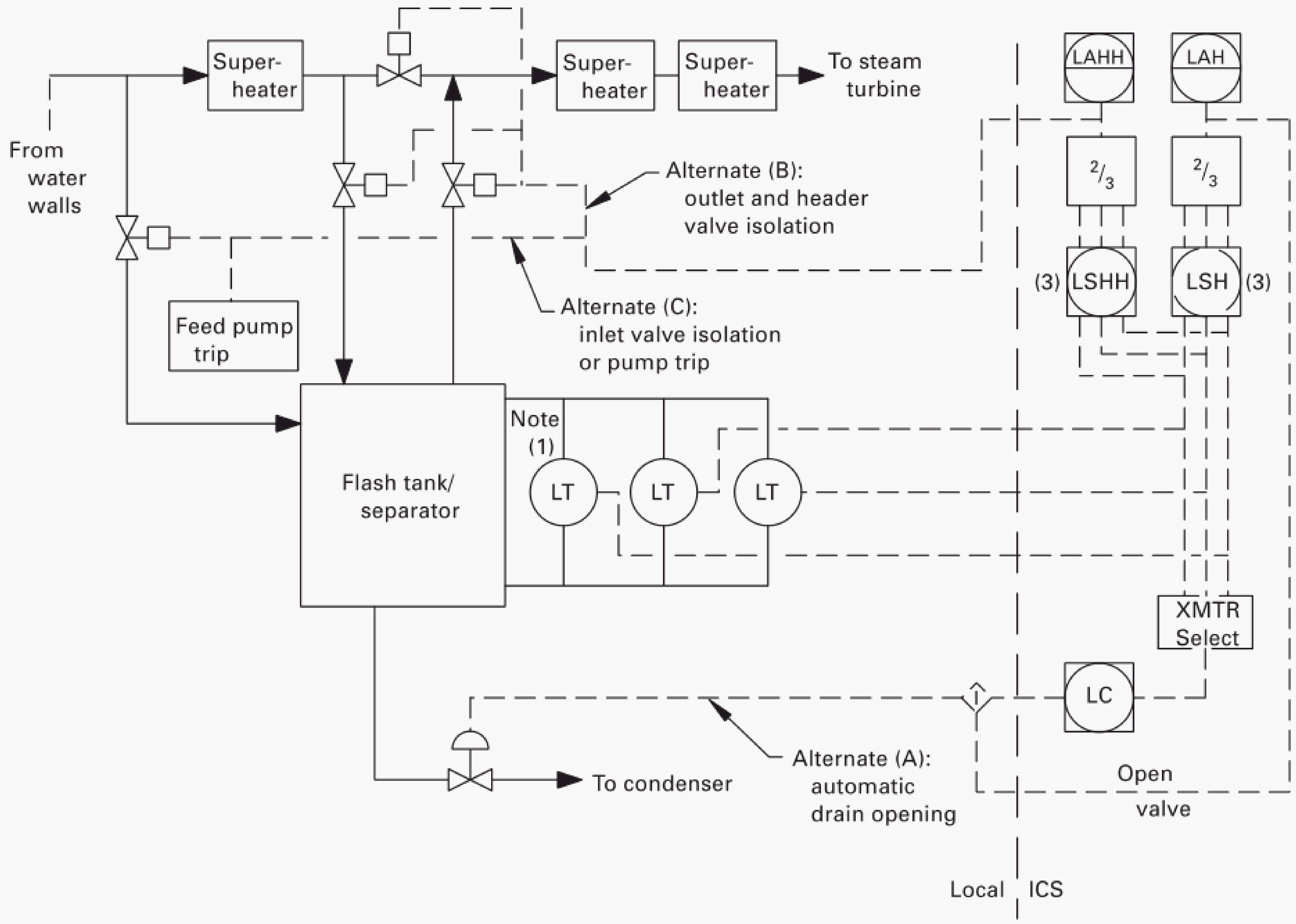
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

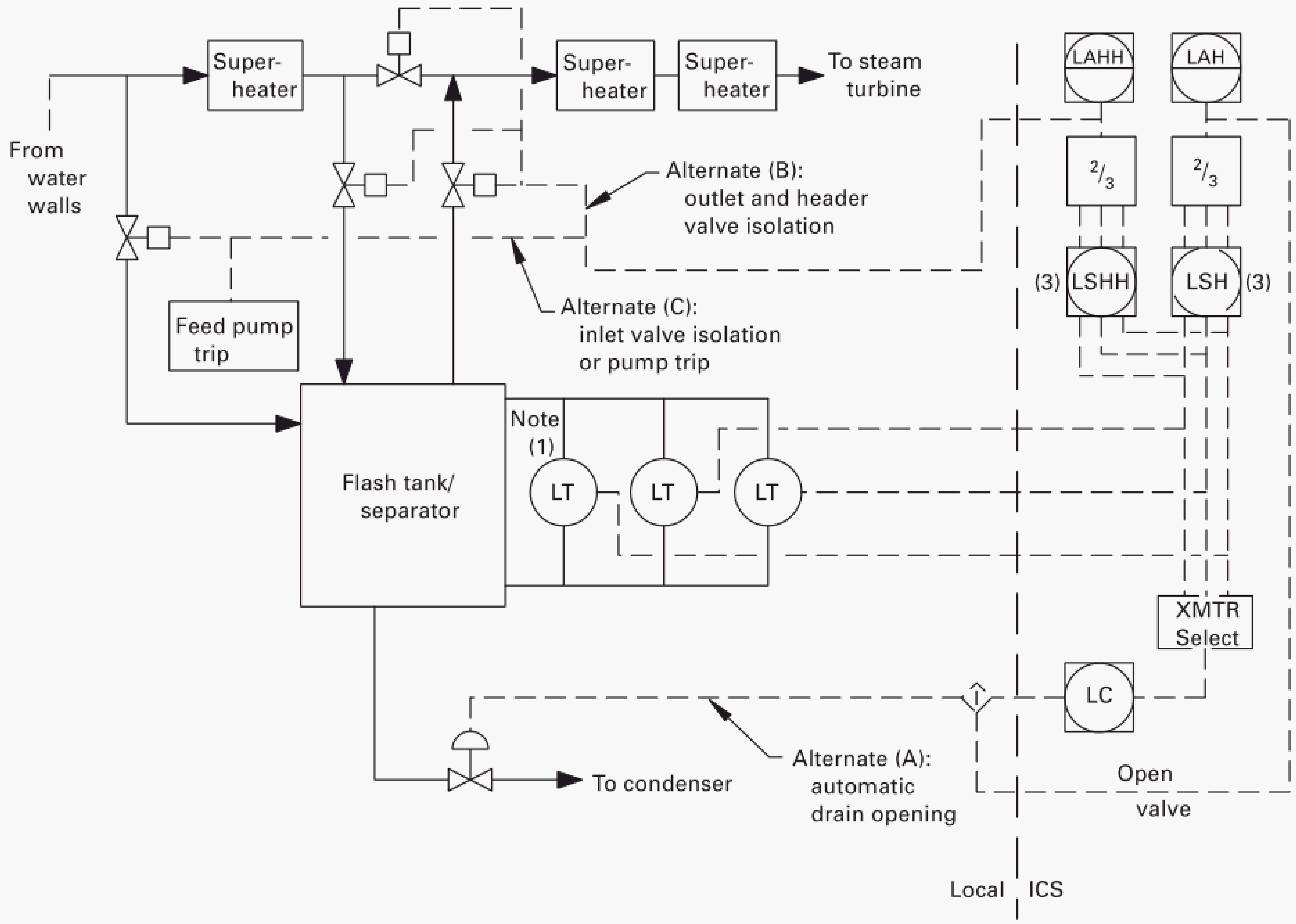
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

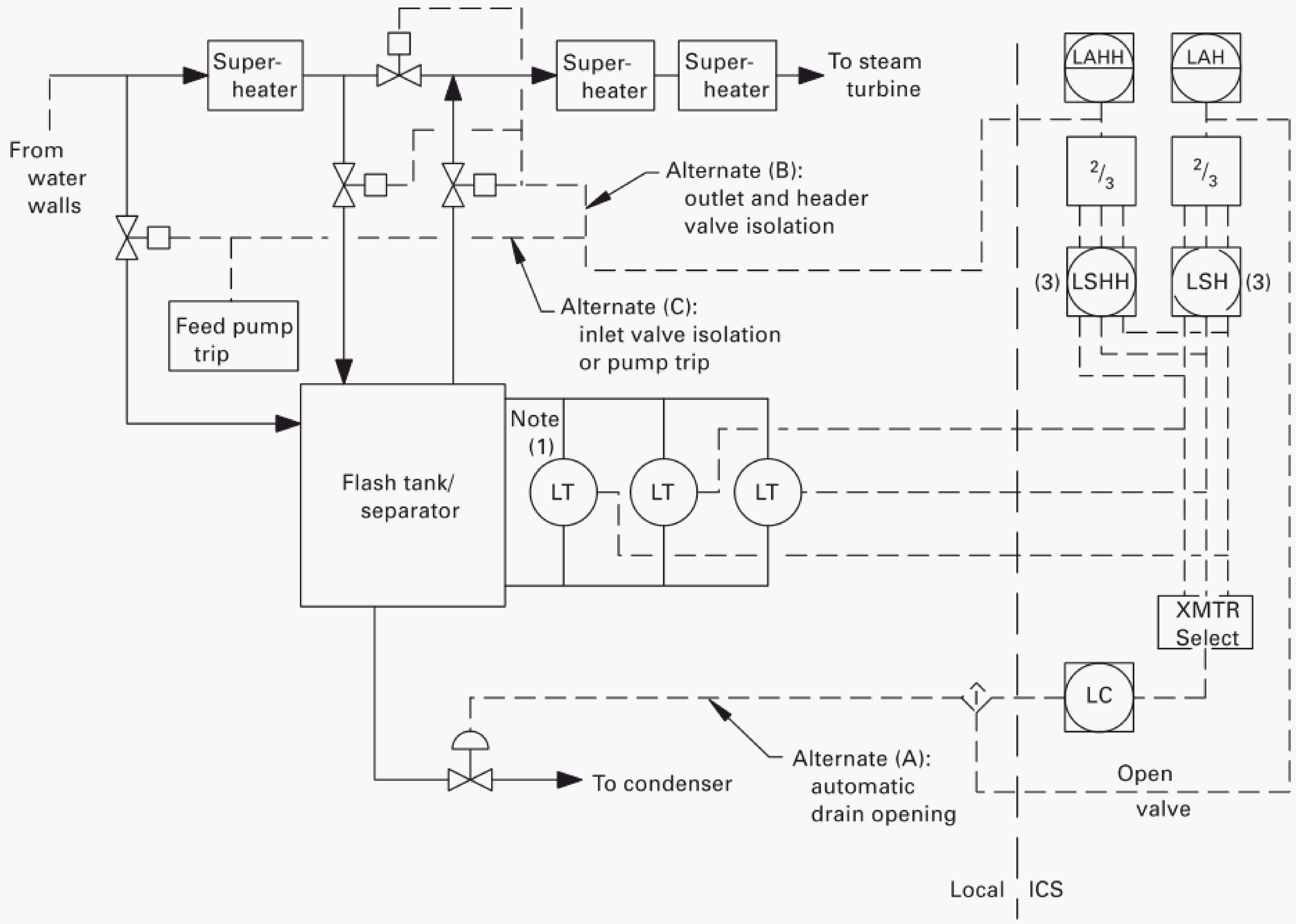
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

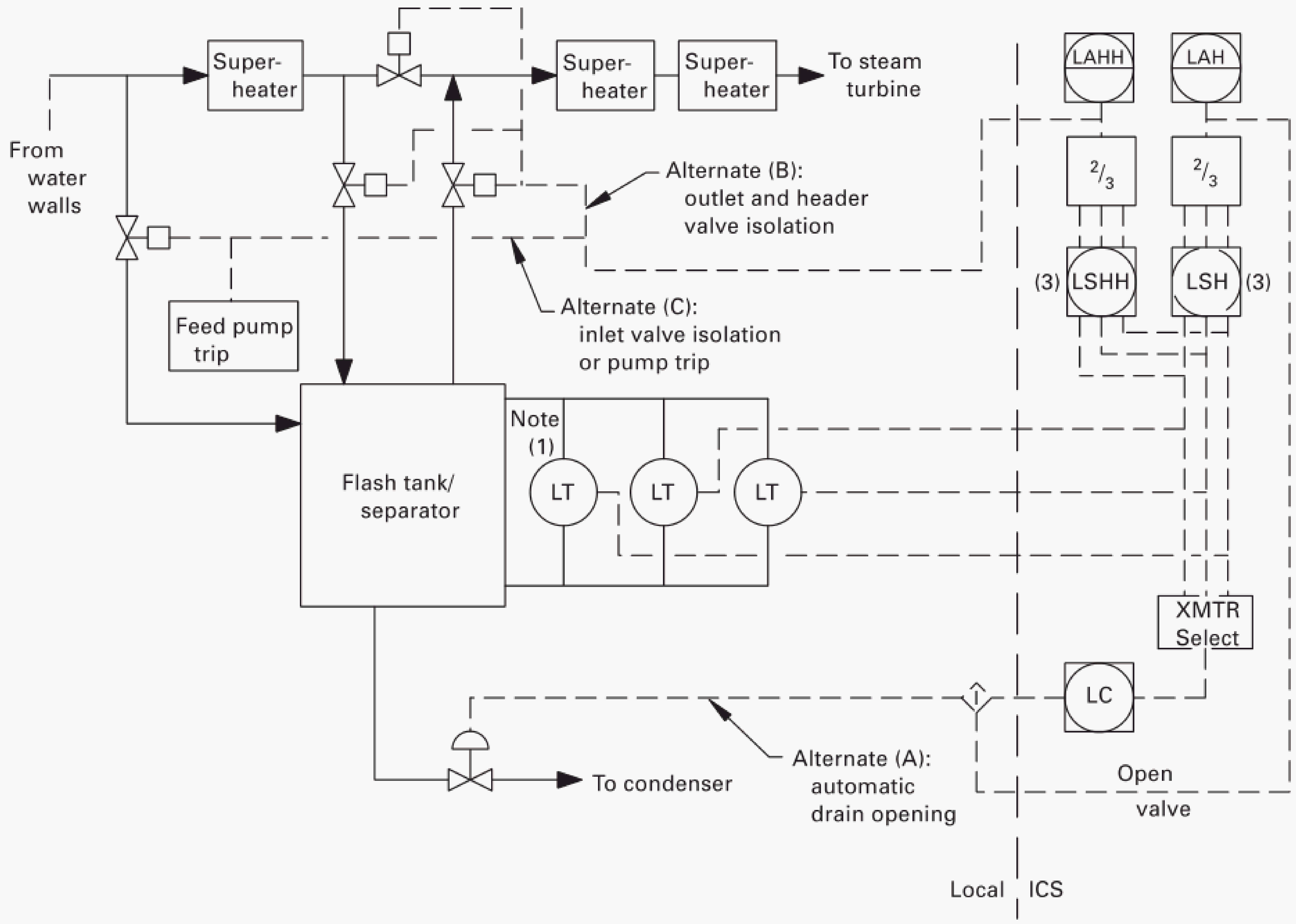
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

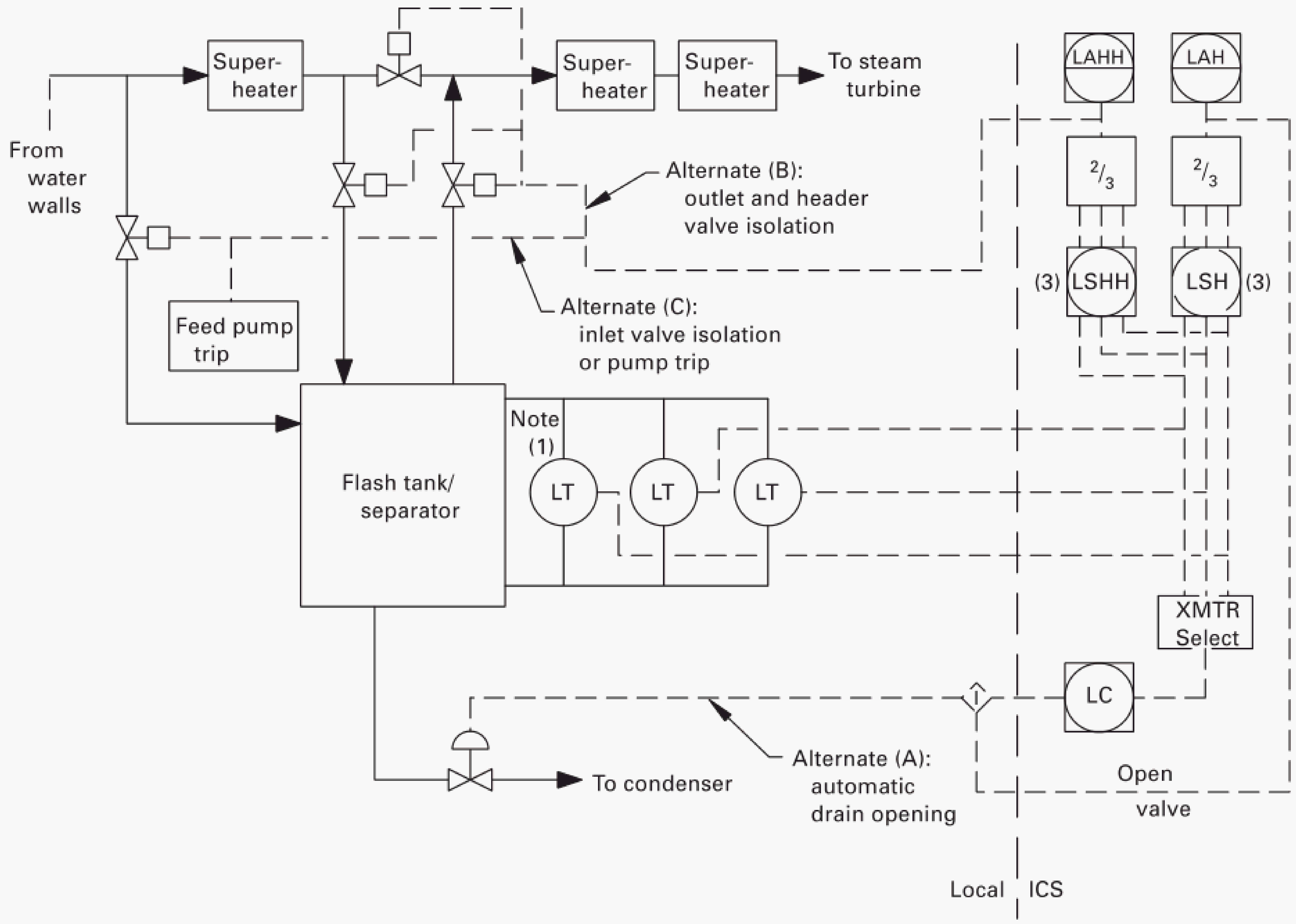
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

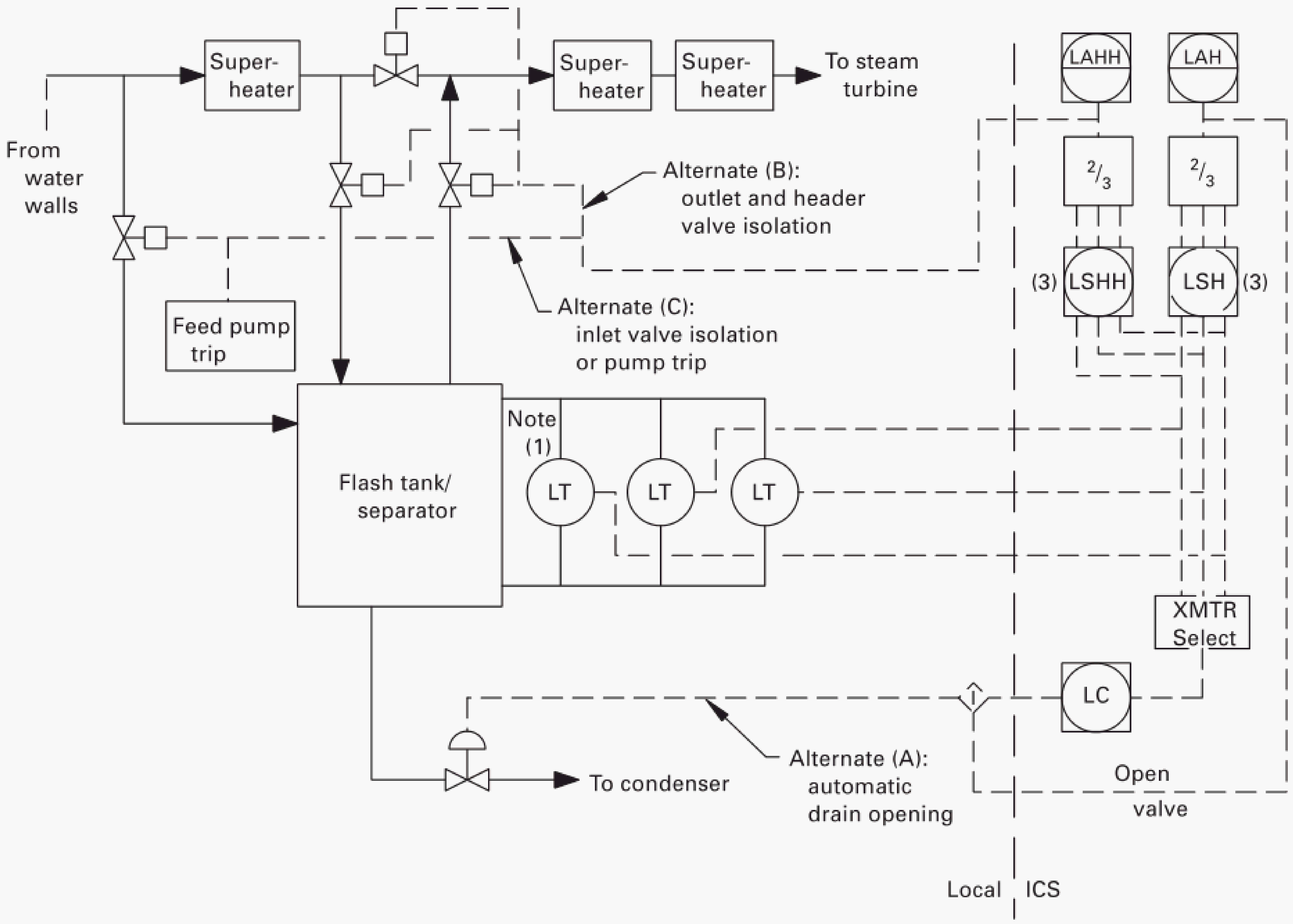
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

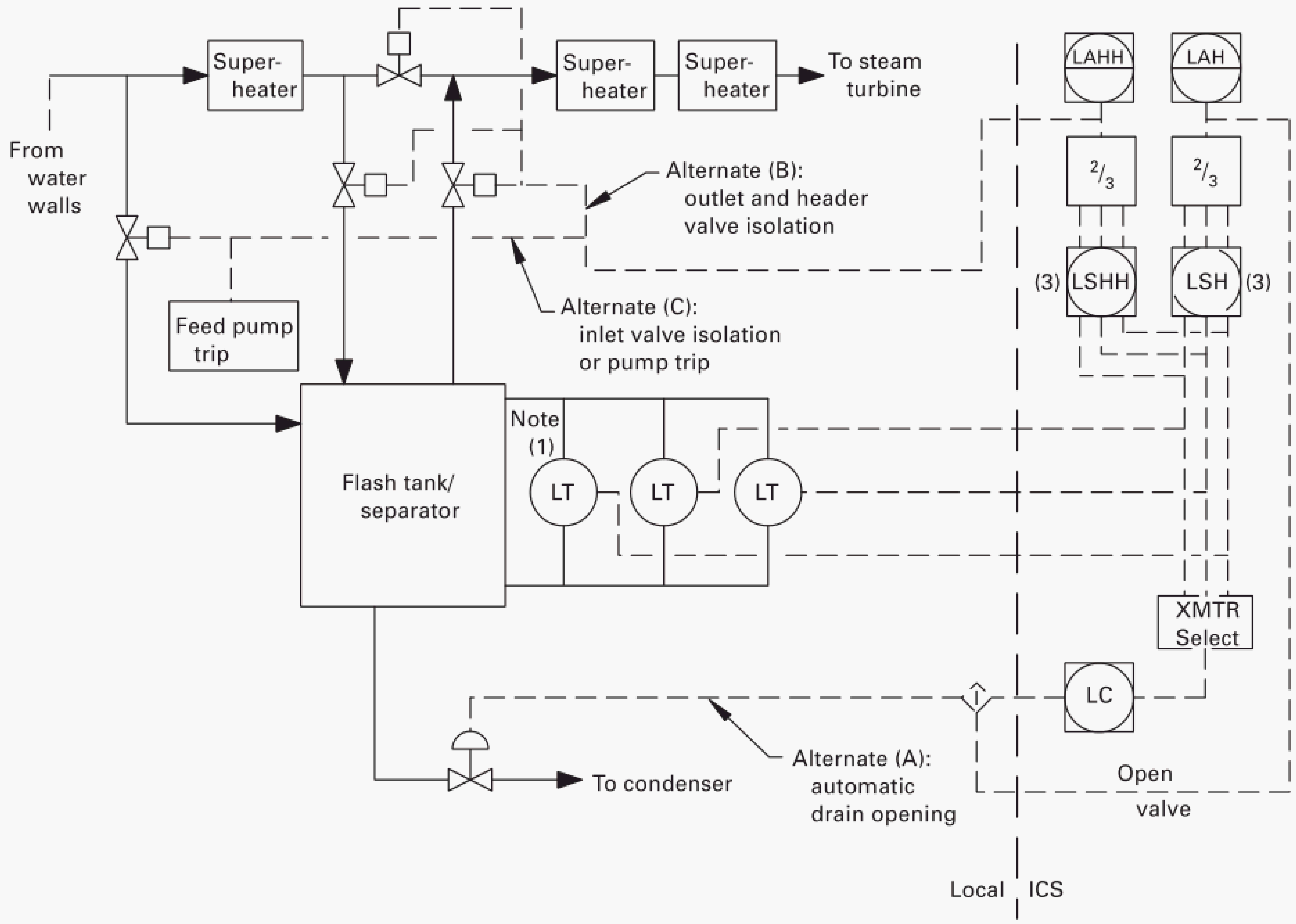
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

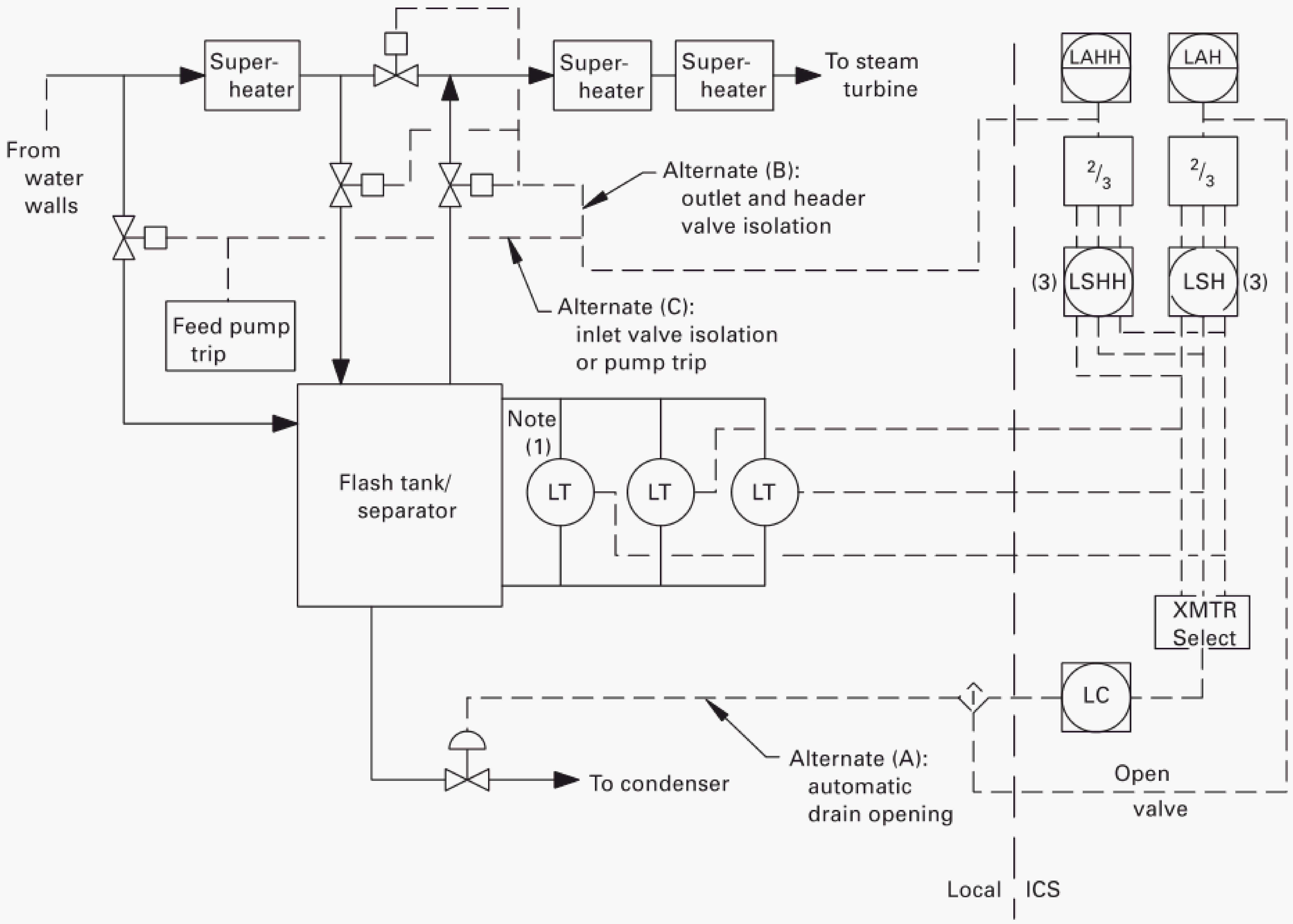
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

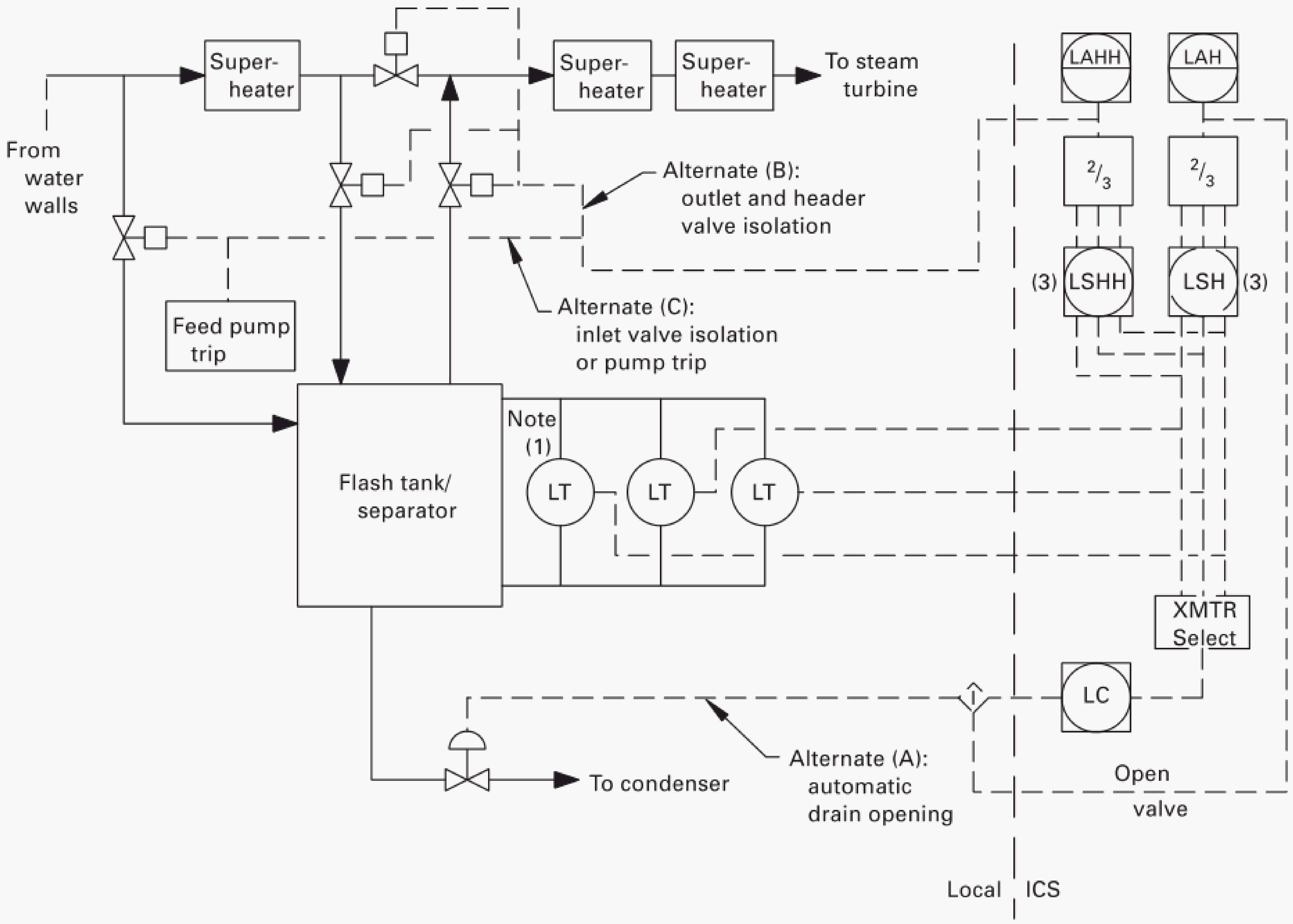
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

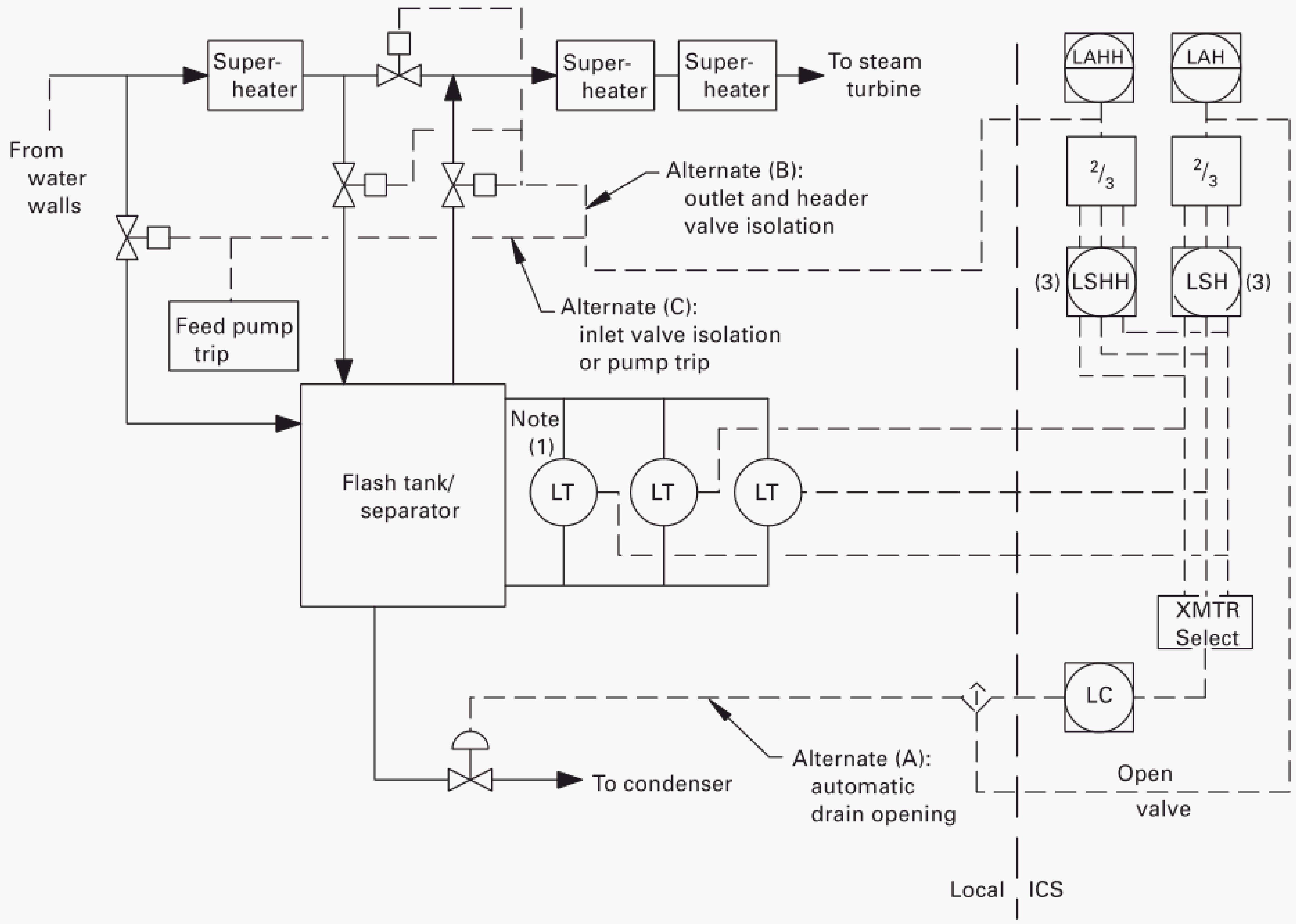
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

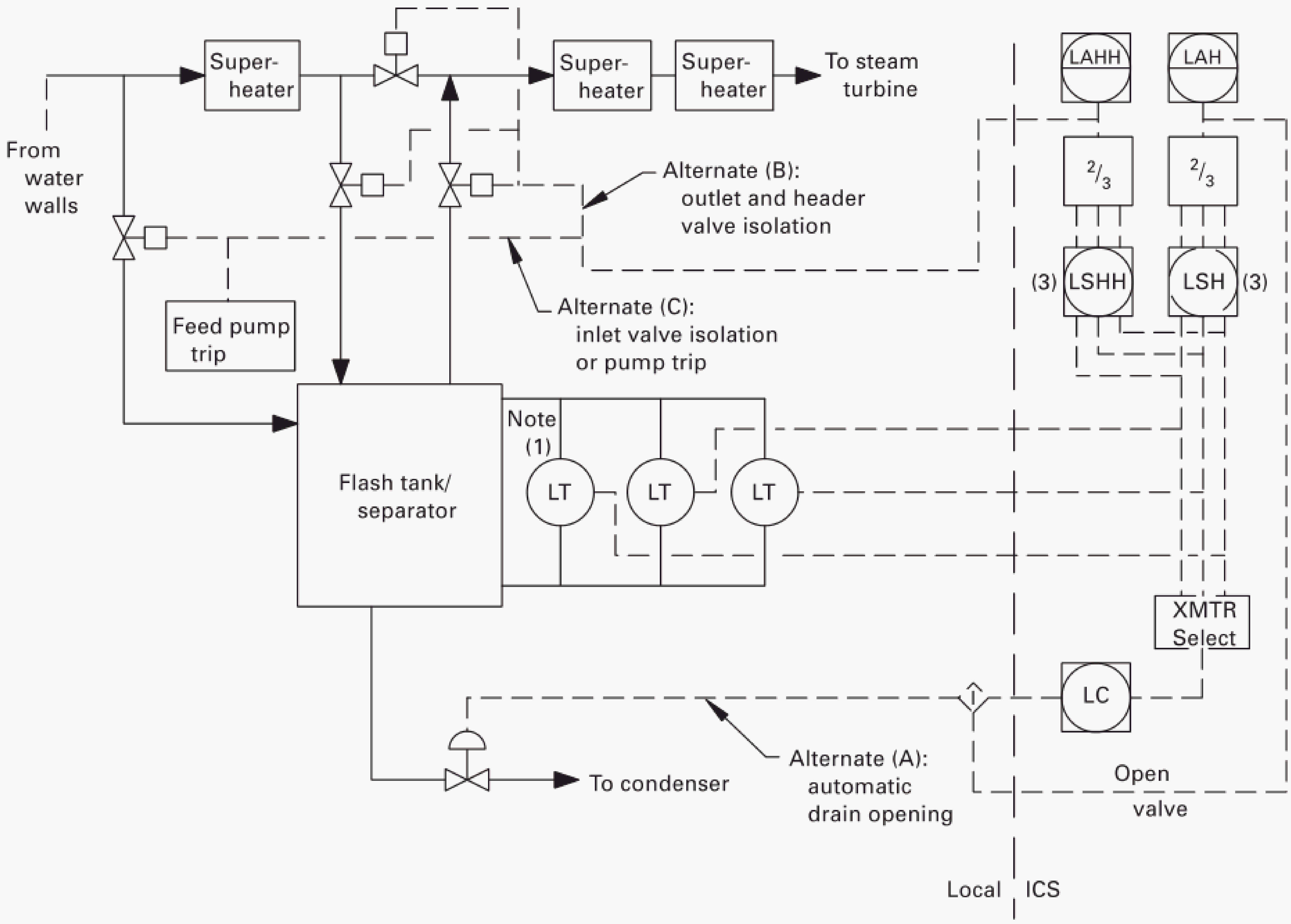
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

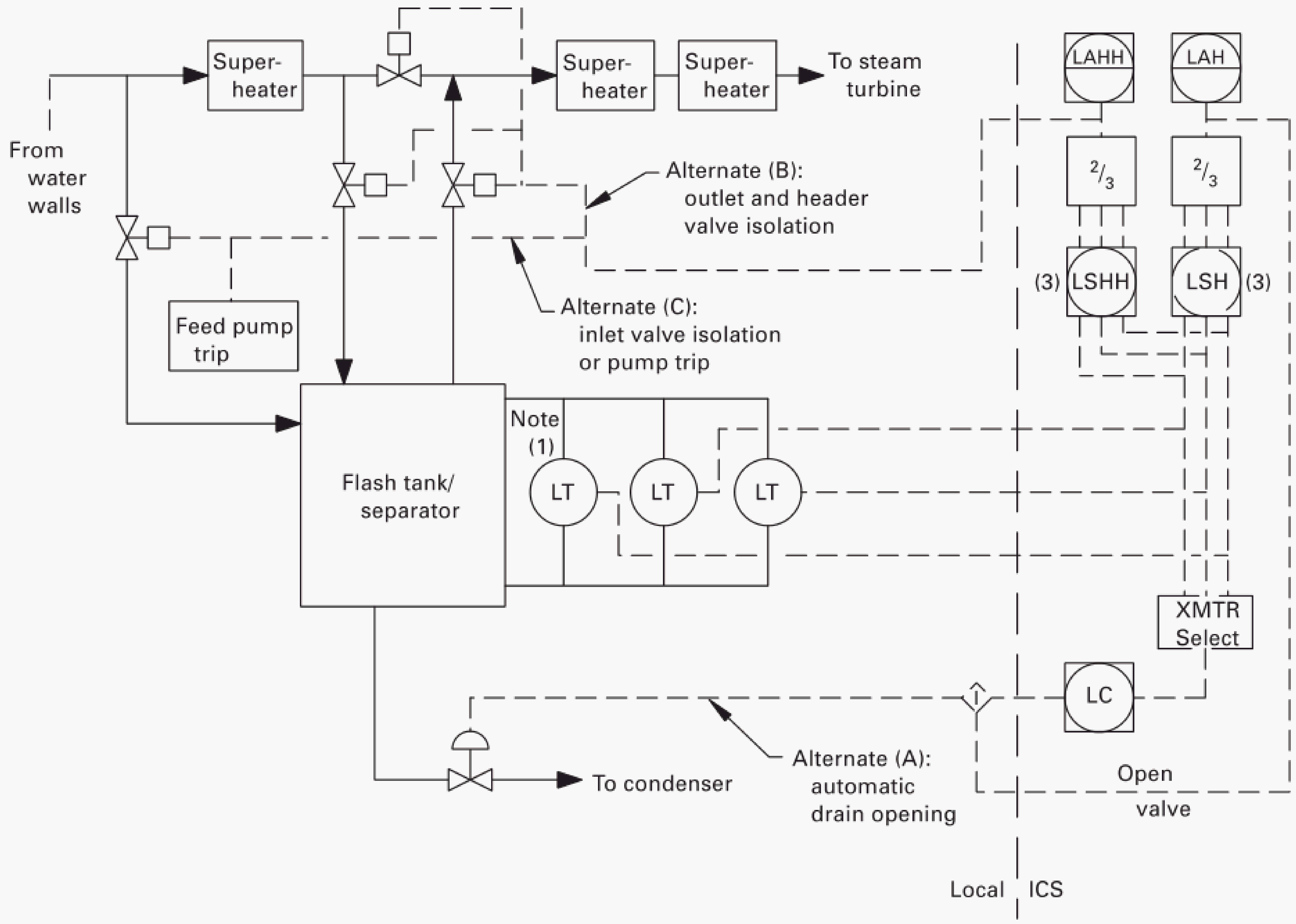
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

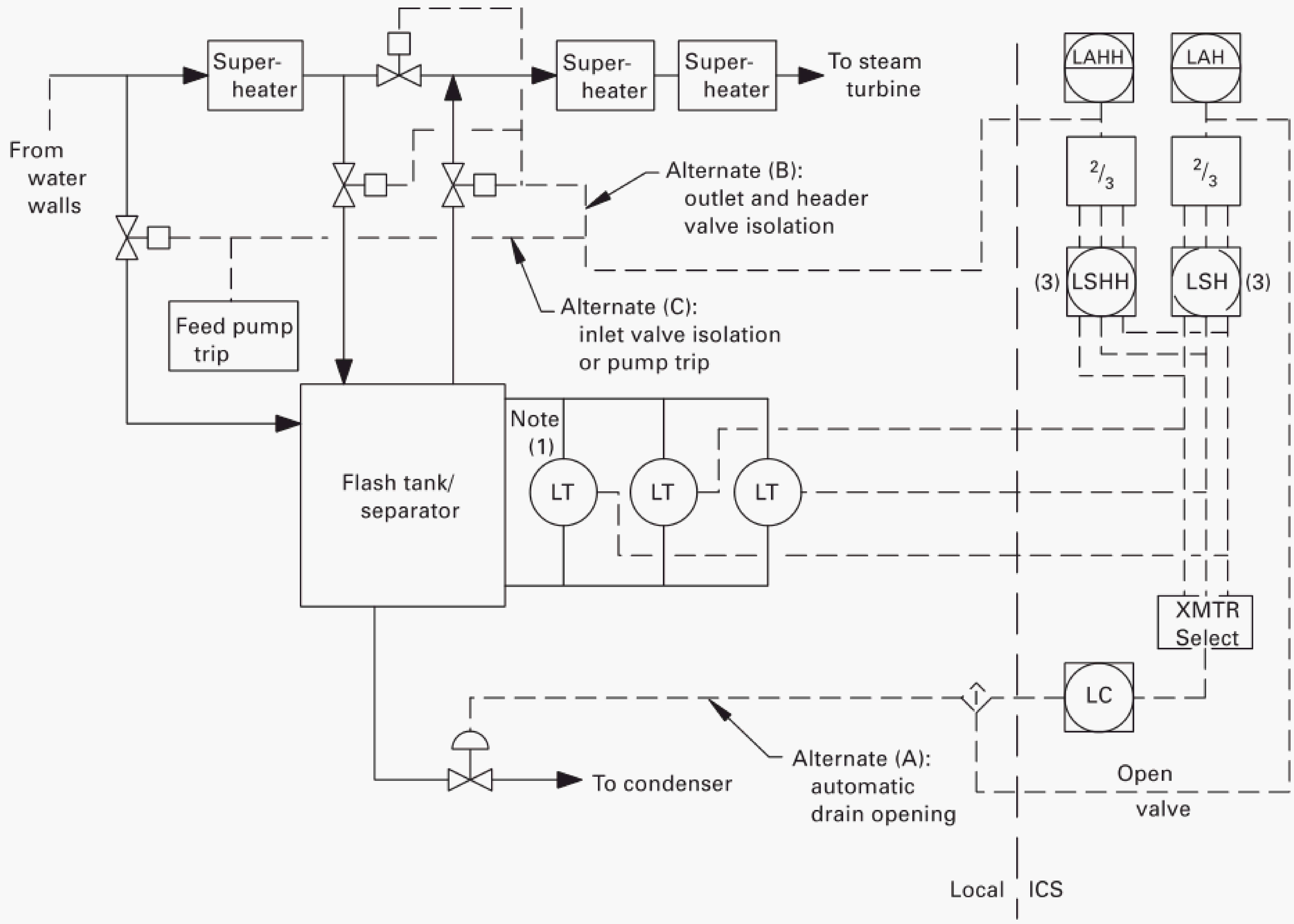
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

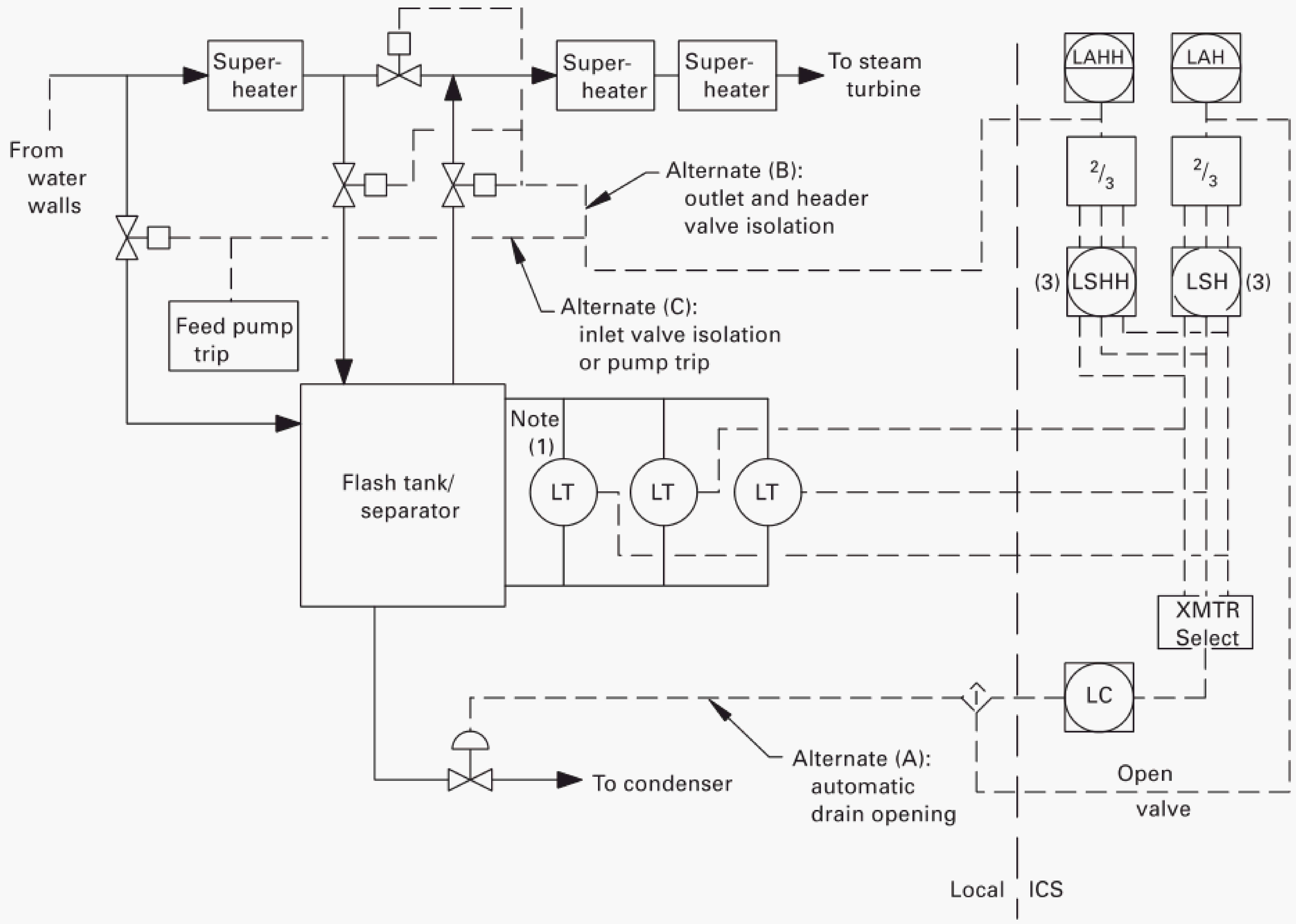
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

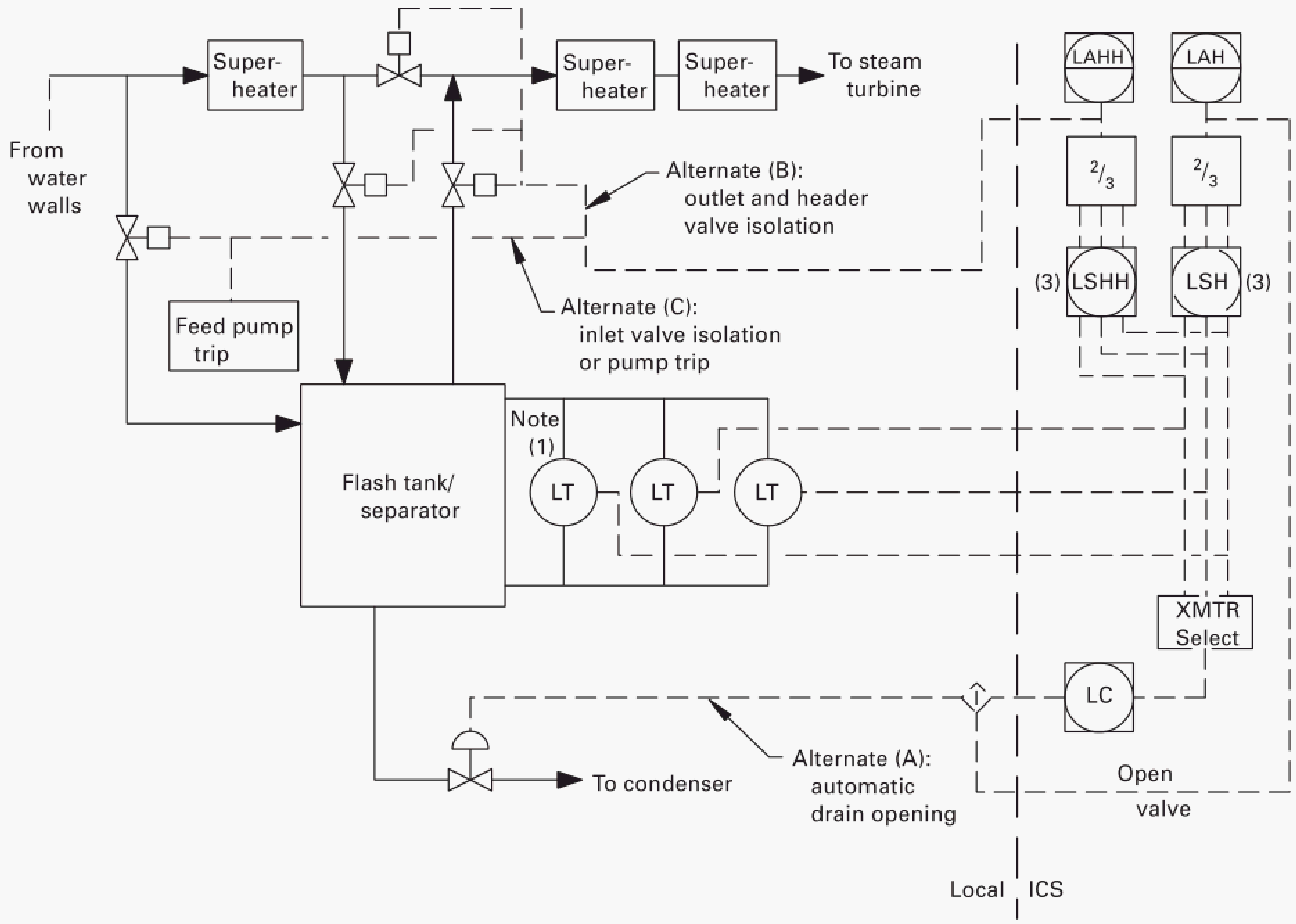
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

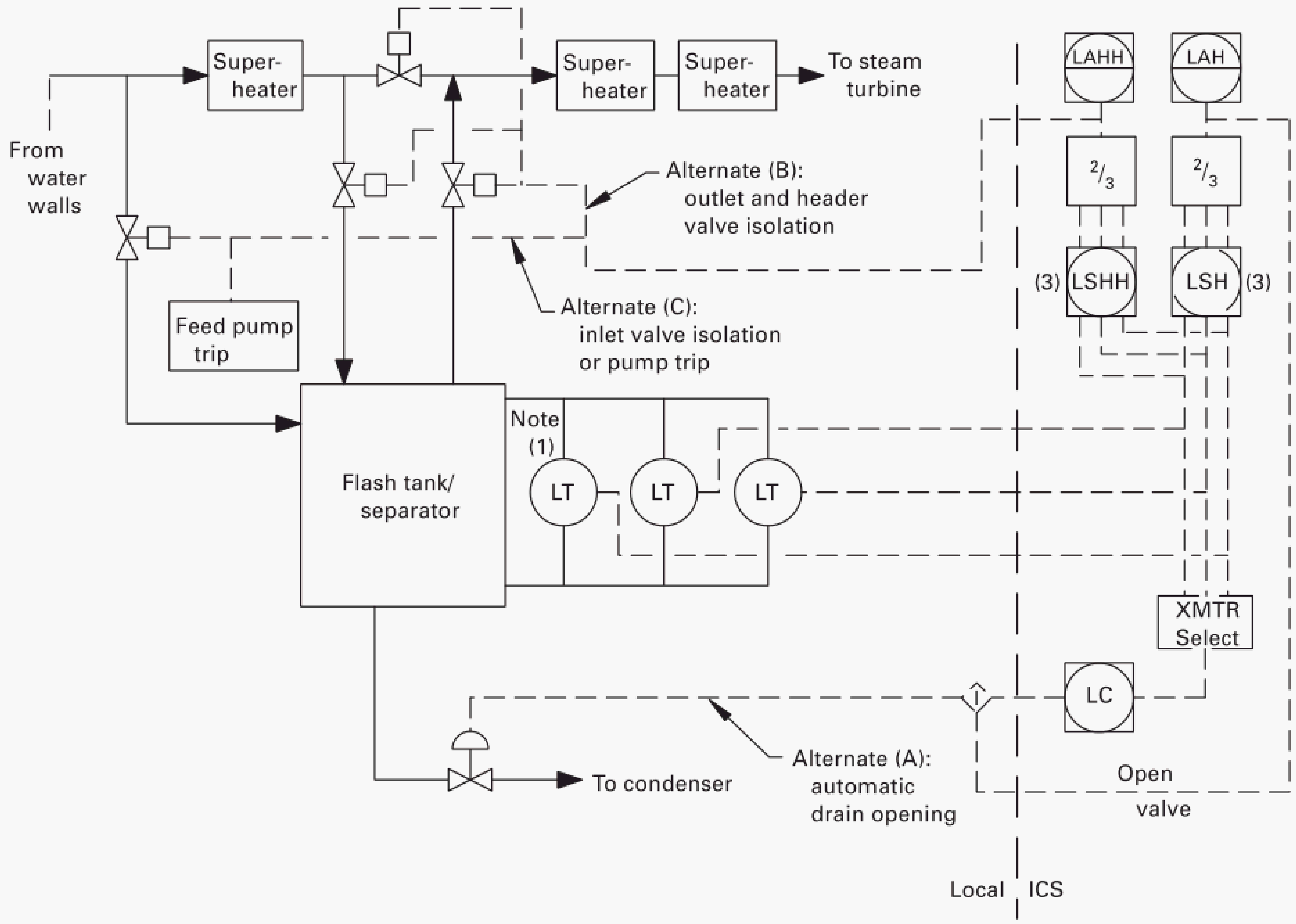
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and / or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

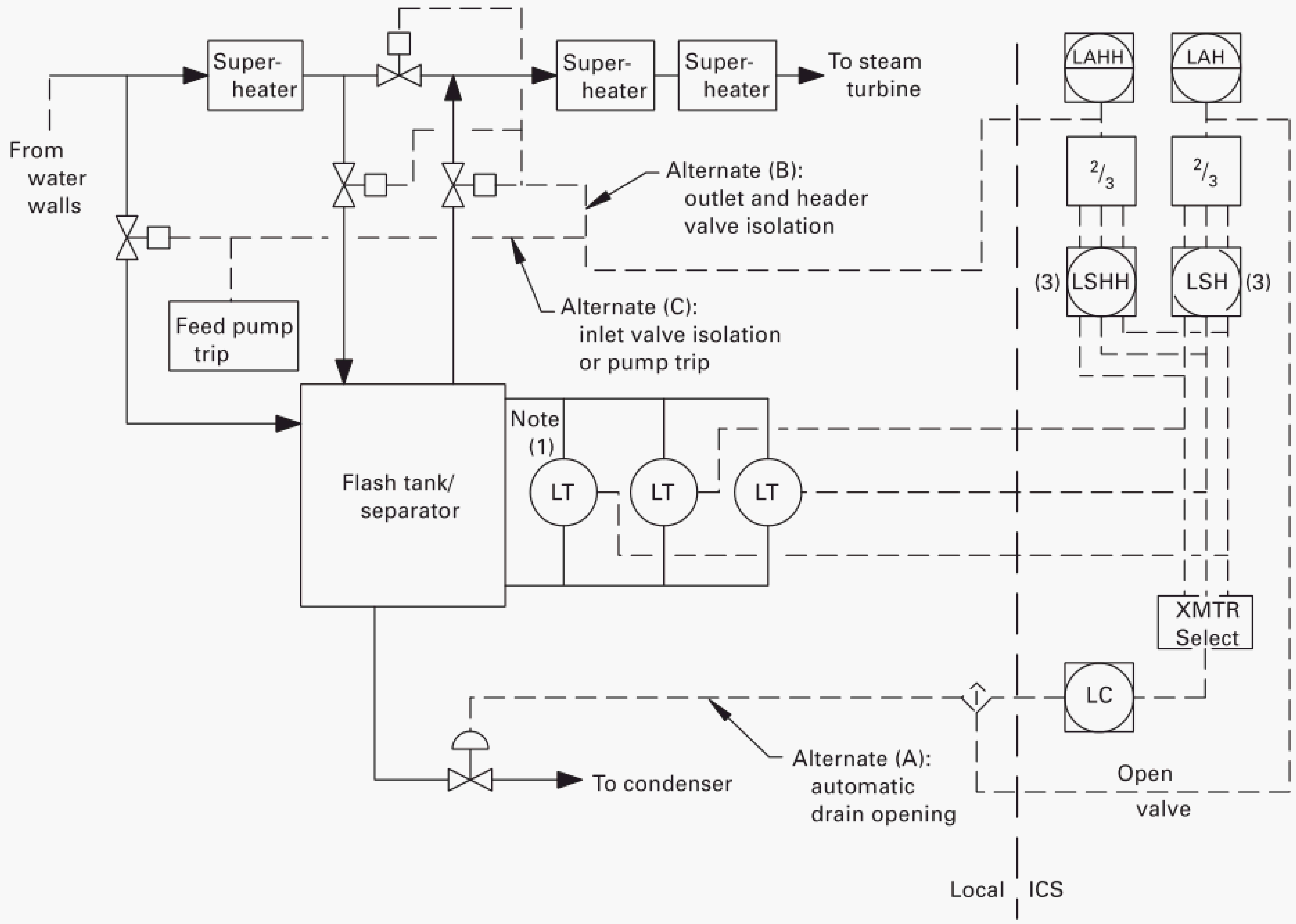
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and / or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

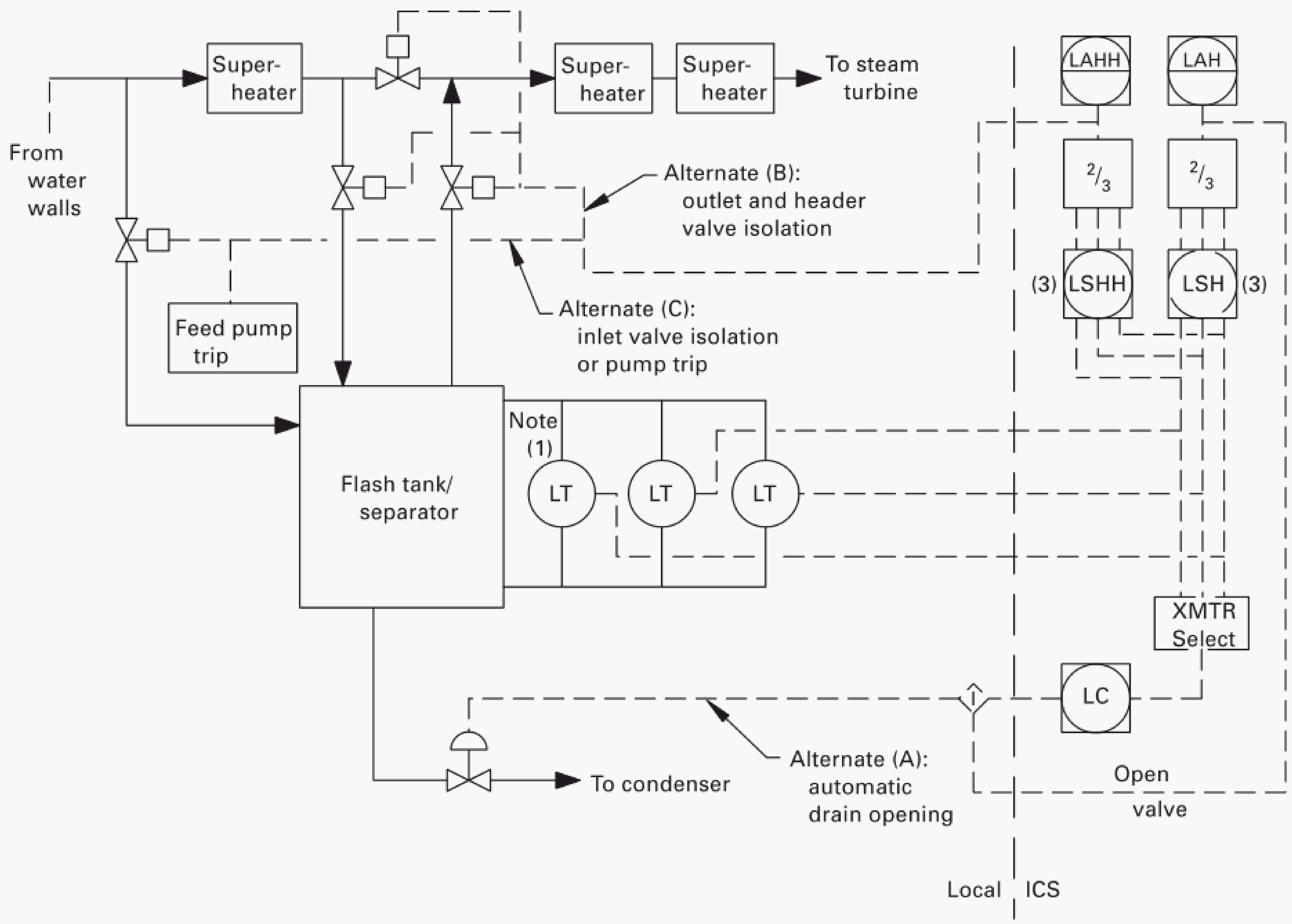
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

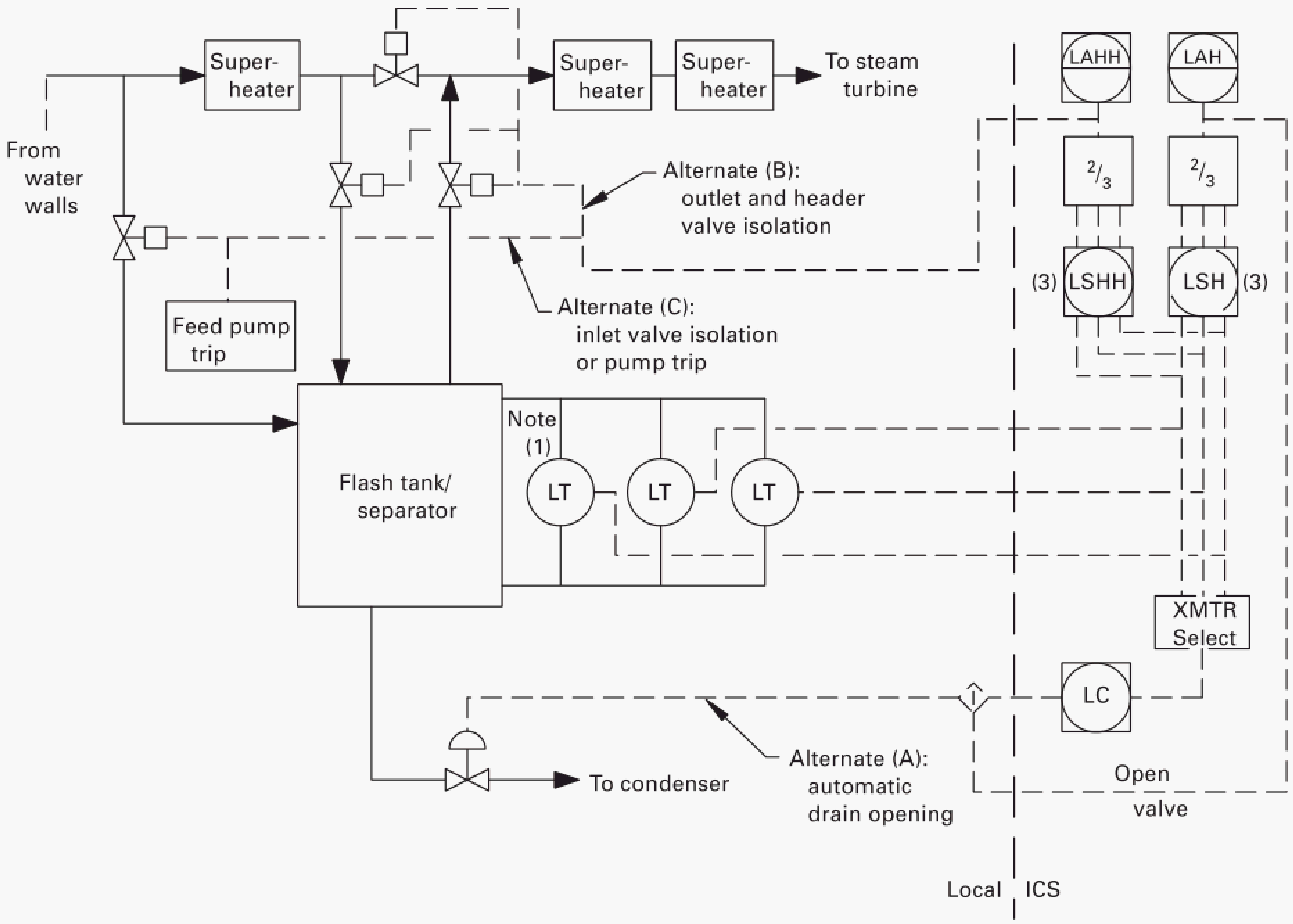
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

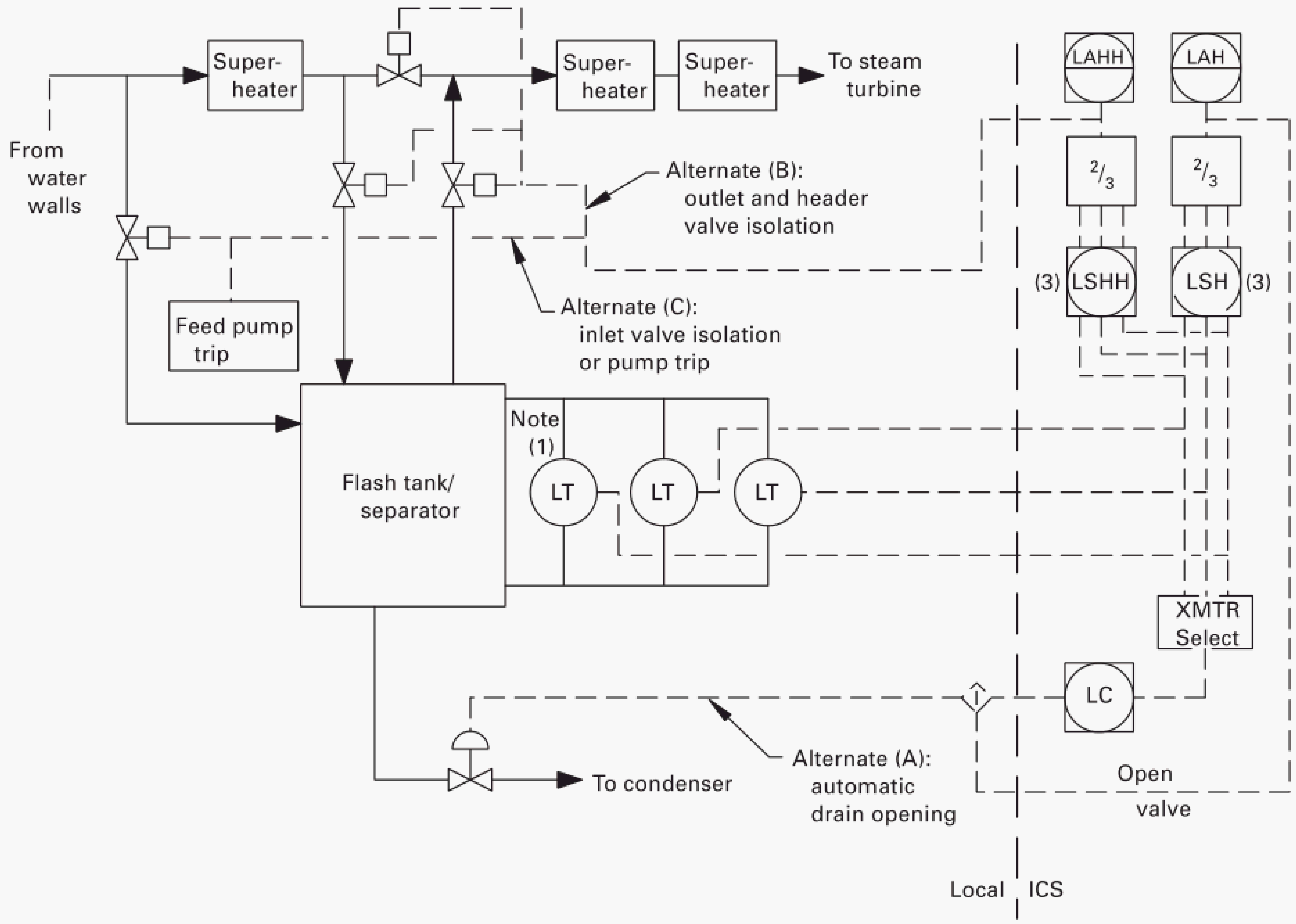
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

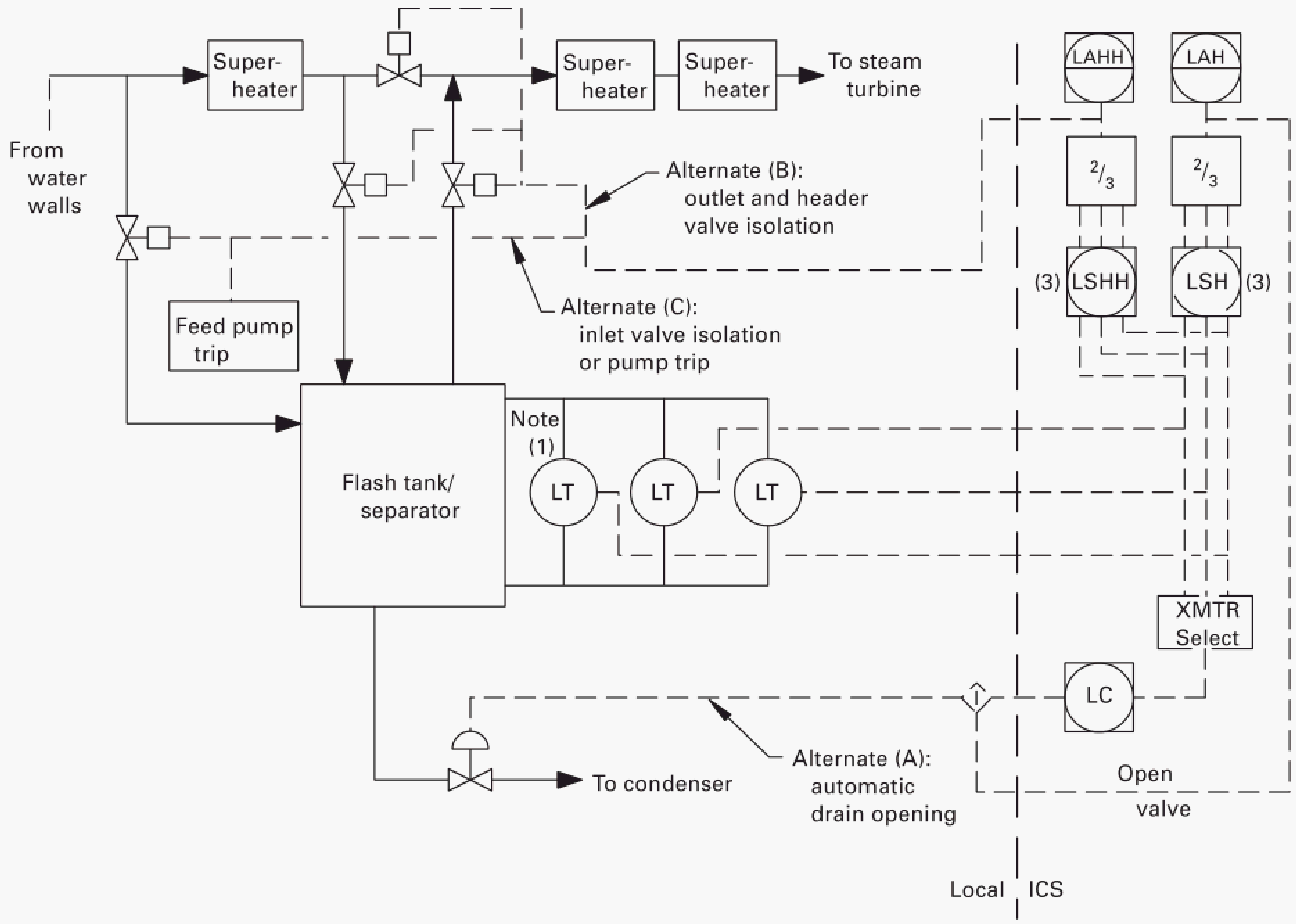
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

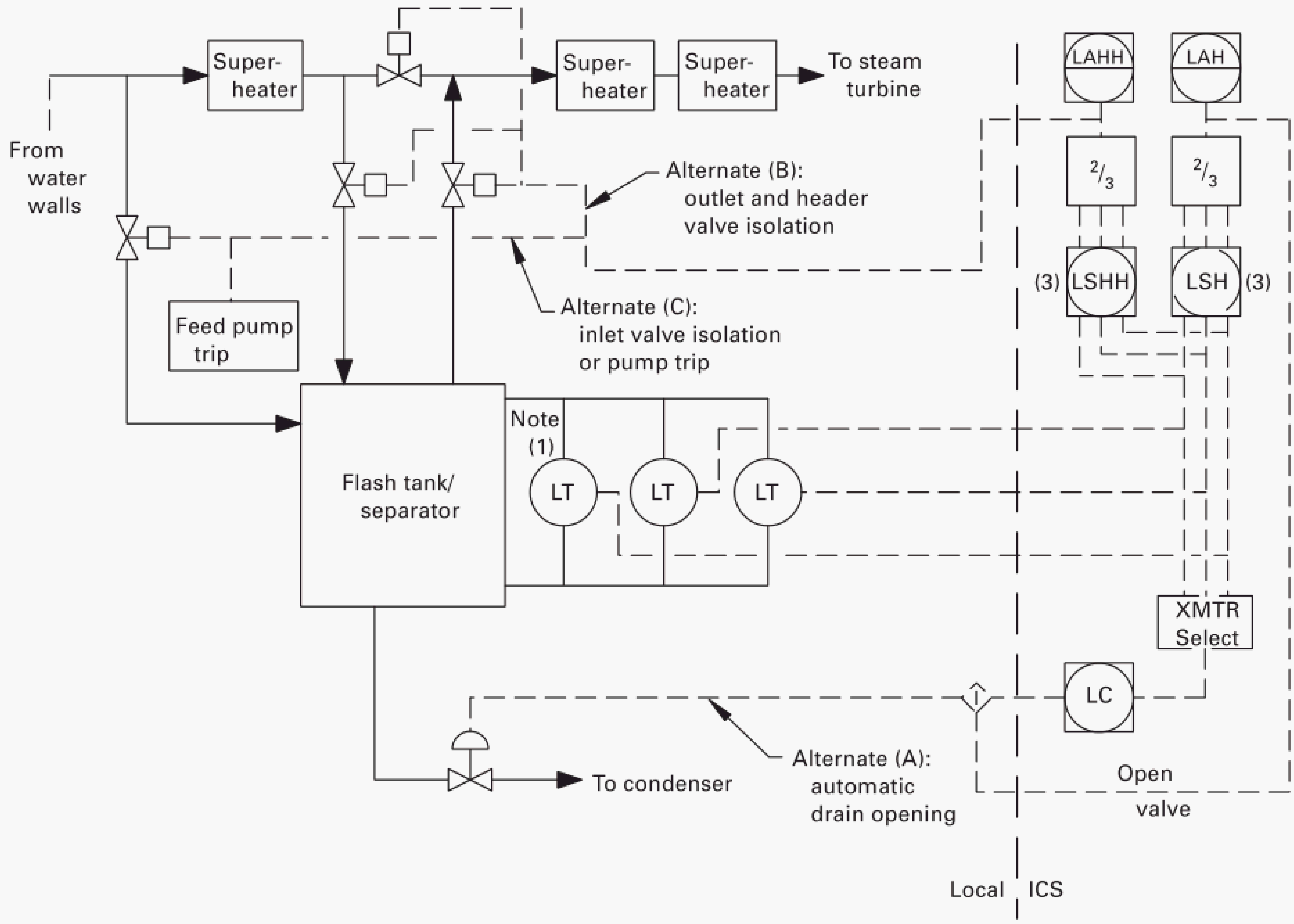
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

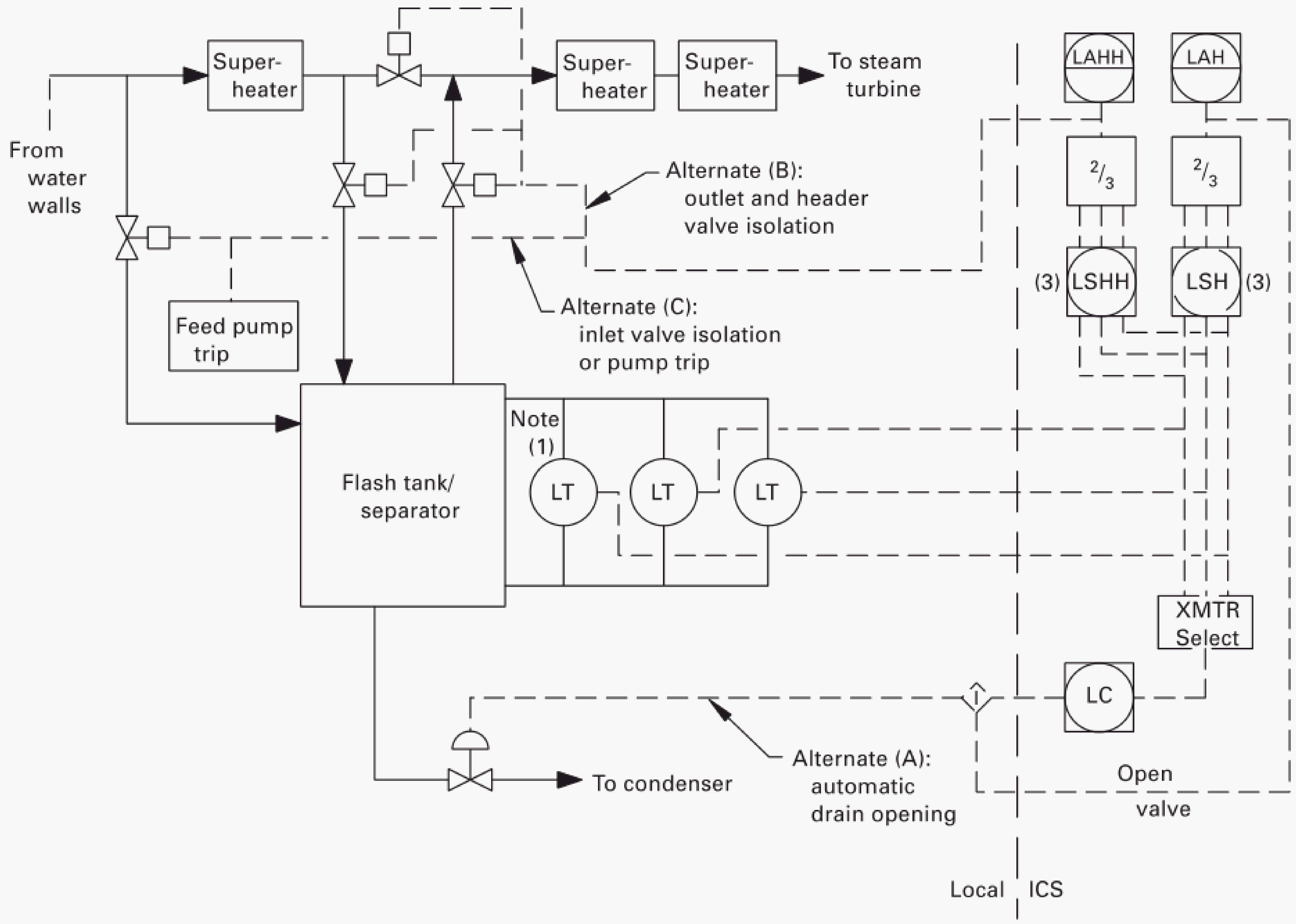
3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even

Fig. 2 Typical Flash Tank/Separators Arrangement: Integrated Control System



NOTE:
(1) Element may be transmitter or high-high level switch.

3.1.3 It is recommended that start-up systems on other than once-through units (such as drum type) be designed so that no single failure of equipment can result in water entering the motive steam line. The design method to best accomplish this objective should be determined by the designer.

3.1.4 Special consideration should be given to drum level control, flash tank level control, and/or leveling vessel control design to realize a high degree of reliability such that no failure of instrumentation or equipment results in a release of water into the motive steam lines.

3.1.5 Heat recovery steam generator (HRSG) system configurations typically include as many as three steam drums, each with level controlled by feedwater valve modulation and condensate or feed pump recirculation or similar method of controlling inflows. The same plant design requirements that apply to other steam generators apply to HRSGs.

3.2 Steam Attemperators

This paragraph applies to all steam attemperators in or connected to motive steam and steam generator systems.

3.2.1 Spray water introduced into the steam generator ahead of the final superheat section is a means to control steam temperature at the superheater outlet. These sprays are generally not effective in controlling final superheat steam temperature at low loads or during turbine roll. The opportunity exists for water to accumulate in the pendant elements of the superheater during low load operation from either condensation or overspraying. Units that operate for extended periods of time with the spray header system charged to full pump discharge pressure (e.g., during start-up and shutdown conditions) are subject to possible leakage of the spray valves. Such leakage can result in water accumulating in the pendant superheater sections and may even