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220 SYSTEM BOUNDARIES

RECORD OF REVISION

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220 SYSTEM BOUNDARIES

1.0 GENERAL

Proper system boundaries are important to ensure that system components receive the appropriate design, operation, and maintenance considerations to ensure the functionality of the system. Clear boundaries are key to development of System and Facility Design Descriptions and drawings that are mutually consistent and complementary. The system boundaries should include both mass transfer and energy transfer boundaries such as piping, heat exchangers, electrical, and pneumatic components so that the limits of the system addressed by the document are clearly defined.

Structuring the boundaries as described will provide a consistent, industry-standard functional engineering approach (this may not always coincide with LANL historical ownership and operational boundaries; however; it may serve as a useful starting point from which to begin discussion of such matters).

The general approach described herein should also be used when subdividing major systems into discrete subsystems.

When the boundary of an interfacing system is unclear, contact the Responsible System Engineer for resolution.

For new facilities and equipment, boundary decisions shall be made in conjunction with use of the official Systems List in ESM Chapter 1 Section 210.

2.0 MECHANICAL AND FLUID SYSTEMS

Mechanical boundaries should be established at isolation points between systems that would allow the system full functionality within the limitations contained in the system interfaces. Use the following conventions in determining mechanical boundaries:

A. Base boundaries on function of mechanical system isolation points (e.g., valve, pump, piping flanges).

B. Determine boundaries by identifying the components that physically isolate one system from another (e.g., valves).

C. Assign components that isolate a primary (e.g., process) system from a secondary (e.g., support) system to the process system unless the purpose of the secondary system is to control the interface (i.e., drain or vent systems, isolation systems, etc.).

D. The boundary between the support and process systems shall be at an isolation valve or definable flange or, if neither exists, a weld.

E. Assign heat exchangers to the system for which the primary heating/cooling function is performed. Process heat exchangers that provide both a heating and cooling function are assigned to the system that, under normal facility conditions, operates at the higher temperature. HVAC heat exchangers with multiple heating and cooling functions are usually considered part of the HVAC system.

F. Valves that form the boundary between a fluid supply manifold and a system that employs the fluid should be part of the supply system; for example, the valves isolating the Instrument Air supply header from the HVAC system control cabinets are considered part of the Instrument Air system.

G. Valves that perform an automatic isolation or throttling function should be assigned to the system in which the control signal is developed; for example, the valves that control the flow of hot water from the hot water supply header to the various HVAC heating coils would be considered part of the HVAC system.

H. Bound and identify motors and their controllers with the equipment of which they are a component. When a separate disconnect switch is used with a motor controller, bound the disconnect switch with the mechanical equipment code.

Example – Mechanical Boundaries

HVAC

A. The heating, ventilation, and air conditioning (HVAC) system includes all ventilation ducting.

B. The heating and cooling coils are within the HVAC system, up to but not including the valves that isolate the heating or cooling medium supply and return. Valves that regulate or throttle the flow of heating or cooling medium (i.e., to control air temperature) are included in the HVAC system.

C. The boundary between the HVAC system and the compressed air system (CA) is immediately downstream of the primary isolation valves between the CA supply header and the various HVAC control cabinets.

3.0 ELECTRICAL SYSTEMS

A. Base electrical distribution system boundaries on the system's rated voltage.

B. The Electrical Distribution (13.8 kV) system includes the 115kV-to-13.8 kV transformers and the step-down transformers (typically 200-600V, but can be higher) fed by the 13.8 kV. The system begins after the disconnect upstream of the 115/13.8 kV transformer and extends to the low voltage bushings on pad-mounted step-down transformers and at the service entrance equipment for pole-mounted step-down transformers.

C. Electrical systems include the circuit breakers, fuses, and switchboards that control the distribution of electrical power.

D. Put hand switches and motors in the same system as the driven equipment.

E. Equipment sensing or actuating electrical distribution components and equipment for the protection or operation of the electrical distribution system are considered part of the electrical distributing system.

F. Where circuit breakers control specific equipment, the circuit breaker is assigned to the controlled system. The system boundary is between the stabs on the breaker and the bus bar or on the line side connections of the breaker. Circuit breakers that control the distribution of electrical power are assigned to the electrical distribution system.

G. The ***close*** and ***trip*** portions of the control circuit associated with the breaker are included in the load system. The remainder of the control circuit should be included in the associated electrical power distribution system.

Example: – Electrical Boundaries

HVAC

A. For circuit breakers controlling power to active HVAC components the boundary is located between the circuit breaker stabs and the bus bar supplying power to the breaker, or at the line side connection to the circuit breaker, as applicable.
B. For fire alarm control circuits, the boundary is located on the fire alarm side of the contacts.

4.0 INSTRUMENTATION AND CONTROL SYSTEMS

A. Assign sensors (e.g., elements, transmitters, indicators, etc.,), instrumentation, controls and actuators (e.g., switches, control indication, etc.,) that function wholly within a single system to that system.

B. Identify instrumentation, controls and actuators (e.g., programmable controllers, integrated control indication, etc.,) that function between several systems as an instrumentation and control system. The exception to this rule relates to instrument buffers and power supplies as follows:

- *A power supply should be assigned to the same system as the instrument to which it supplies power.*
- *A buffer should be assigned to the same system as the instrument from which it receives a signal.*

C. If an instrumentation and control system is identified, assign the sensors and actuators to the instrumentation and control system, unless the sensor or actuator is required to maintain physical integrity of the primary system. In the latter case, assign the sensor or actuator to the primary system and the boundary identified at the connection nearest to the primary system.

D. Controls (e.g., switches, controllers, etc.) are included in the system that they control, unless such devices are provided as part of an overall control system.

E. Assign the instrumentation and metering associated with an **electrical bus** to the electrical distribution system that it measures. Instrumentation and metering associated with a **load breaker** are included in the load system.