

TECHNICAL MANUAL

**RELIABILITY DATA COLLECTION
MANUAL FOR COMMAND,
CONTROL, COMMUNICATIONS,
COMPUTER, INTELLIGENCE,
SURVEILLANCE AND
RECONNAISSANCE (C4ISR)
FACILITIES**

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HEADQUARTERS, DEPARTMENT OF THE ARMY

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CHAPTER 1

INTRODUCTION

1-1. Purpose

This document provides guidance to facilities engineers responsible for site utility systems at command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) facilities. This manual describes a level of data collection activities which should be performed on control, power generation and distribution, and heating, ventilating and air conditioning (HVAC) equipment for the preparation of reliability studies for operational readiness.

1-2. Scope

The information in this document will describe the required information necessary to determine the reliability and availability of a component. Explanations and descriptions of the different metrics are also covered as well as the preferred methods. Data collection listings are also provided for various pieces of equipment to aid the data collection process. Gathering the correct information is the most vital aspect of determining accurate availability and reliability values of components.

1-3. References

Appendix A contains a complete list of references used in this manual.

CHAPTER 2 BACKGROUND

2-1. Requirements

Requirements are set forth in TM 5-691, Utility Systems Design Requirements for Command, Control, Communications, Computer, Intelligence, Surveillance, and Reconnaissance (C4ISR) Facilities, for the design of optimally reliable, self contained C4ISR utility systems and for the design of conventional power and other utility services. These utility services should be capable of supplying services continually to the C4ISR installation during all natural or man-made disruptions in commercial services. Potential disruptions include physical attacks, biological, chemical, and radiological warfare; as well as high and low altitude nuclear blasts.

2-2. Availability goal

TM 5-691 requires that each C4ISR utility system subsystem have a reliability/availability goal of 0.999999 when calculated using standard reliability techniques. Under certain assumptions this implies that each subsystem downtime will not exceed 32 seconds per year. This goal is of course contingent upon the determination of the using agency that a greater frequency of mission downtime is acceptable and therefore this goal would not apply to certain installations. Also the total reliability/availability of an installation would be dependant on the number of subsystems on site.

CHAPTER 3

RELIABILITY and AVAILABILITY

3-1. Reliability

Reliability determines the probability that a system will fail under specified use and environmental conditions. It is quantified by using time to failure metrics such as failure rate and mean time between failures (MTBF). Equation 1 is commonly used to calculate reliability.

$$\text{Reliability (for time interval } t), R(t) = e^{-\lambda t} \quad (\text{Equation 1})$$

a. Failure rate describes the number of failures that have occurred during a specified time interval and MTBF describes the average time a unit will operate before failing. Both are calculated with the unit in the manufacturer's specified environment. Both of these quantities are statistical metrics that are dependent on the failure distribution of the unit. Most manufacturers provide MTBF or failure rate for their products.

b. There exists several metrics by which commercial utilities measure reliability. These metrics all measure the average availability of power to the distribution system and the utility's customer. Although these metrics are used for evaluating a utility's system, they are not used for basic reliability modeling of non-utility systems and components. Utility metrics are customized specifically for utilities. The more common of these metrics are:

- (1) System average interruption frequency index (SAIFI)
- (2) System average interruption duration index (SAIDI)
- (3) Customer average interruption duration index (CAIDI)
- (4) Average service availability index (ASAI)

3-2. Availability

Reliability and availability are often confused as being the same metric. They are related but are not the same quantity. Availability is the ability of a product or service to be ready for use when the customer wants to use it. There are several definitions of availability. Commonly used availability equations are:

$$\text{Inherent availability, } (A_i) = \text{MTBF}/(\text{MTBF}+\text{MTTR}) \quad (\text{Equation 2})$$

$$\text{Operational availability, } (A_o) = \text{MTBM}/(\text{MTBM}+\text{MDT}) \quad (\text{Equation 3})$$

Where:

MTBF is mean time between failures
 MTTR is mean time to repair
 MTBM is mean time between maintenance
 MDT is mean down time

a. *Inherent availability* is the instantaneous probability that a component will be up. Inherent availability considers only downtime for repair due to failures. Preventative maintenance and logistics time are *not* included.

b. *Operational availability* is the instantaneous probability that a component will be up but differs from inherent availability in that it includes *all* downtime. Included is downtime for both corrective maintenance and preventative maintenance, including any logistics delay time

CHAPTER 4

DATA COLLECTION

4-1. Required information

Five categories of information contain the necessary data for reliability modeling: Site Identification, Site One Line Drawings, Name Plate Information, Critical Equipment Designation and Sparing, and Maintenance Data. When combined, this information gives the analyst all the necessary data to populate a reliability model. Data collection for the C4ISR site is not intended to be done in a single setting nor in a single month. This is an ongoing activity that should be completed in as timely a manner as possible without impacting the readiness of the facility. Once completed, updates to the information are only necessary as maintenance is performed on the equipment.

4-2. Site identification data

Site identification data provides basic information about the equipment and the particular C4ISR site. *Site identification data* consists of:

- a. Date of the Survey – Establishes the site configuration baseline date.
- b. Facility Name/ID number/Location – Identifies the facility
- c. Equipment Facility Name/ID – Identifies the equipment with a site specific ID number, name or location.
- d. In Service Date – Provides the date the equipment was installed which gives the analyst a starting point to calculate time to failure metrics.
- e. Parent System – Allows the equipment to be assigned to the proper site subsystem.

4-3. Site one line drawings

One line drawings are used to develop the reliability block diagrams and can indicate reliability borders for the electrical distribution, pneumatic, or plumbing systems. The one line also indicates critical and redundant equipment, systems, and circuits. These drawing may also provide length of wires and pipe which are needed for the reliability models.

4-4. Nameplate information

Nameplate information identifies the equipment and its specifications which allow the analyst to obtain time to failure data from the equipment manufacturer or to utilize commercial, industrial, or military failure databases such as the Institute of Electronic and Electrical Engineers (IEEE) Std 493™ *IEEE Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems* (Gold Book) or the US Department of the Army's TM 5-698-5, *Survey of Reliability and Availability Information for Power Distribution, Power Generation, and HVAC Components for Commercial, Industrial, and Utility Installations*. Name Plate Data consists of:

- a Equipment Manufacturer
- b Equipment Model

- c Equipment Type
- d Equipment Ratings

4-5. Critical equipment designation and sparing

Critical equipment designation and sparing data identifies equipment that is critical to the mission of the particular C4ISR site. Critical equipment must be highly reliable; generally more reliable than is practical in a single piece of equipment. This equipment generally has an automatically switched spare or a quickly replaceable spare on site. *Critical equipment designation and sparing data* consists of:

- a. Critical Equipment Designation – Identifies mission critical equipment.
- b. Redundant Equipment – Identifies the presence or lack of redundant equipment for critical equipment.
- c. Spares – Identifies on site critical equipment spares.

4-6. Maintenance data

Maintenance data provides the reliability analyst with time to failure data as well as insight into the level of periodic maintenance performed on a piece of equipment. Time to failure data provides data for calculation of time to failure metrics while periodic maintenance data allows a validation of manufacturer supplied failure data. This data contains both scheduled and unscheduled maintenance actions. Scheduled maintenance lists periodic maintenance while unscheduled maintenance lists equipment failures and repairs. Maintenance data typically exists in hand written log books or computerized maintenance records.

CHAPTER 5

DATA COLLECTION LISTINGS

5-1. Description

The data listings in Appendix B have been developed for the facility engineer's use. These listings contain the necessary data to be collected on the equipment. In order to keep the listings to a minimum there is a single listing for each classification of equipment. For example, on listing H8-000 there are three types of boilers: hot water, low pressure steam, and high pressure steam. This single listing will be used to gather data on all three types of boilers.

5-2. Categories and Listing Titles

Facility equipment has been divided into three categories: Control Equipment, Electrical Power Generation and Distribution Equipment, and HVAC Equipment. Table 5-1 lists Control Equipment, Table 5-2 lists Power Generation and Distribution Equipment, and Table 5-3 lists HVAC Equipment.

Table 5-1. Control equipment

Item #	Equipment Classification
C1-000	Circuit Card Assembly
C2-000	Computer
C3-000	Control Center
C4-000	Control Panel
C5-000	Gauge
C6-000	Meter
C7-000	Network Hub
C8-000	Pressure Control Assembly
C9-000	Pressure Regulator
C10-000	Programmable Logic Controller (PLC)
C11-000	Remote Terminal Unit (RTU)
C12-000	Control System
C13-000	Sending Unit
C14-000	Thermocouple
C15-000	Thermostat
C16-000	Transducer
C17-000	Valve Operator

Table 5-2. Electrical power generation and distribution equipment

Item #	Classification Level
E1-000	Arrester, Lightning
E2-000	Battery
E3-000	Bus Duct, All types
E4-000	Cabinet Heater
E5-000	Cable Connection
E6-000	Cable, AC
E7-000	Cable, Aerial
E8-000	Cable, DC
E9-000	Cable, Communication
E10-000	Capacitor/Capacitor Bank
E11-000	Charger, Battery
E12-000	Circuit Breaker
E13-000	Distribution Panel
E14-000	Drive
E15-000	Engine
E16-000	Filter, Electrical
E17-000	Fuse
E18-000	Generator, Diesel Engine
E19-000	Generator, Gas Turbine
E20-000	Generator, Hydro Turbine
E21-000	Generator, Natural Gas
E22-000	Generator, Steam Turbine
E23-000	Generator, Steam, Heat Recovery
E24-000	Heater
E25-000	Inverter, All Types
E26-000	Line Conditioner, All Types
E27-000	Motor Generator Set
E28-000	Motor Starter
E29-000	Motor, Electric
E30-000	Oil Cooler
E31-000	Recloser (Interrupter)
E32-000	Rectifier, All Types
E33-000	Relay
E34-000	Switch
E35-000	Switchboxes Panels
E36-000	Switchgear
E37-000	Tank
E38-000	Transformer
E39-000	UPS: Uninterruptible Power Supply
E40-000	Voltage Regulator

Table 5-3. Heating, ventilating and air conditioning (HVAC) equipment

Item #	Classification Level
H1-000	Accumulator
H2-000	Air Compressor
H3-000	Air Conditioner
H4-000	Air Dryer, All Types
H5-000	Air Handling Unit
H6-000	Air Separator, All Types
H7-000	Blower
H8-000	Boiler
H9-000	Cabinet Heater/Radiator
H10-000	Chiller
H11-000	Compressor, Refrigerant
H12-000	Condenser
H13-000	Convactor
H14-000	Cooling Tower
H15-000	Damper Assembly
H16-000	Dehumidifier
H17-000	Direct fired furnace
H18-000	Evaporator
H19-000	Fan
H20-000	Filter, Mechanical
H21-000	Heat Exchanger
H22-000	Heat Pump
H23-000	Humidifier
H24-000	Humistat Assembly
H25-000	Pipe
H26-000	Pump
H27-000	Strainer
H28-000	Valve
H29-000	Water Cooling Coil
H30-000	Water Heater

CHAPTER 6

POWER RELIABILITY ENHANCEMENT PROGRAM (PREP) ITEM IDENTIFICATION CROSS REFERENCE GUIDE

6-1. Purpose

The PREP Item Cross Reference Guide in appendix C is supplied to help cross reference the new *item* numbers currently being used to the previous component identification of *kind* numbers.

a. This alteration was needed because the prior component identification numbering system made it difficult to categorize similar components under a like classification in a hierarchical structure. The design of the prior component identification numbering system made it impossible to add a new component, which was similar to other components other than in size or capacity, to a like group of numbers.

b. The previous component identification system also made it difficult to roll up like classes into a more generic classification of a component. This can be explained better by providing an example of cables in different classifications based on size and application. Three different types of cable:

- (1) AC cable, above ground, 0-600volts, in conduit, item #E6-111
- (2) AC cable, above ground, 0-600volts, in trays, item #E6-112
- (3) AC cable, above ground, 0-600volts, no conduit, item #E6-113

c. All three of these classes can have their own failure rates, availability numbers ...etc. But if the analyst did not have either of these specific classifications known to him, a generic failure rate could be obtained by "rolling up" one level to AC cable, above ground, 0-600 volts, item #E6-110 using the next level of "Item #'s" for AC cable. This "rolling up" process can keep going up one more level getting more and more generic all the way up to AC Cable, item #E6-000.

6-2. Classifications

All new assigned PREP identifications have a letter classifications provided that breaks out the *Power Generation, Distribution and Electrical component* by adding the prefix "E" to the item number. It also separates the *HVAC components* with the prefix "H" and the *Controls and Monitoring components* with the prefix "C". This can make sorting through the entire list of components a lot less cumbersome.

a. Although the prefixes provide a big advantage to cataloging the components, there were some components that could possibly fall within two different categories (i.e., Power Generation and HVAC). Some of these components are listed below at the "highest level" along with their Item Number.

- | | |
|-------------------|----------|
| 1. Cabinet Heater | #E4-000 |
| 2. Engine | #E15-000 |
| 3. Heater | #E24-000 |
| 4. Oil Cooler | #E30-000 |
| 5. Tank | #E37-000 |

b. These items could have been categorized in HVAC as well, but do to their association with power generation components (i.e., Engine, Diesel) it was decided to categorize them with the prefix "E". Therefore, it may be necessary to look in both categories.

APPENDIX A

REFERENCES

Required Publications

Government Publications:

US Army Corps of Engineers (USACE)

TM 5-691, *Utility Systems Design Requirements for Command, Control, Communications, Computer, Intelligence, Surveillance, and Reconnaissance (C4ISR) Facilities*, 15 December 2000. (cited in paragraphs 2-1 and 2-2).

TM 5-698-5, *Survey of Reliability and Availability Information for Power Distribution, Power Generation, and HVAC Components for Commercial, Industrial, and Utility Installations*. (cited in paragraph 4-4).

Non-Government Publications:

Institute of Electronic and Electrical Engineers (IEEE) Std 493™ *IEEE Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems* (Gold Book). (cited in paragraph 4-4)

Related Publications

Government Publications:

MIL-STD-3007B,
Standard Practice for Unified Facilities Criteria and Unified Facilities Guide Specifications

Air Force Civil Engineering Support Agency (AFCESA)

AFH32-1282V2.pdf, *Field Guide for Inspection, Evaluation, and Maintenance Criteria for Electrical Transformers*

AFH 32-1282V1.pdf, *Field Guide for Inspection, Evaluation and Maintenance Criteria for Electrical Substations and Switchgear*

AFI 32-1062, *Electrical Power Plants and Generators*

AFI 32-1063, *Electrical Power Systems*

US Army Corps of Engineers (USACE)

ARMY TM 5-683

NAVY NAVFAC MO-116

AIR FORCE AFJMAN 32-1083, *Facilities Engineering Electrical Interior Facilities*.

ARMY TM 5-684
NAVY NAVFAC MO-200
AIR FORCE AFJMAN 32-1082, *Facilities Engineering Electrical Exterior Facilities*

TM 5-688, *Foreign Voltages and Frequencies Guide*

TM 5-692-1, *Maintenance of Mechanical and Electrical Equipment at Command, Control, Computers, Communications, Intelligence, Surveillance, and Reconnaissance (C4ISR) Facilities, Recommended Maintenance Practices.*

TM 5-692-2, *Maintenance of Mechanical and Electrical Equipment at Command, Control, Computers, Communications, Intelligence, Surveillance, and Reconnaissance (C4ISR) Facilities, System Design Features.*

TM 5-693, *Uninterruptible Power Supply System Selection, Installation, and Maintenance for Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) Facilities.*

ARMY TM 5-811-1
AIR FORCE AFJMAN 32-1080, *Electrical Power Supply and Distribution*

Non-Government Publications:

Arthur D. Little, "Reliability and Distributed Generation", White Paper

Carnegie Mellon Electricity Industry Center (CEIC), "Electricity under Stress: Robustness and Economics of Distributed Generation"

EPRI Corp., "Reliability of Electric Utility Distribution Systems: EPRI White Paper"

IEEE "Calculating Electrical Risk and Reliability", Paper No. PCIC 94-3, John Propst, Senior Member, IEEE, Shell Development Company, Houston, TX 77251-1380

IEEE "Power Quality Monitoring for High Reliability Systems", Ross Ignall – Dranetz BMI, Mark McGranaghan, Electrotek Concepts, Mark Figor – DHL

John Propst, Equilon Enterprises, LLC, "Operating Manual for Calculating Electrical Risk and Reliability Using the 2000-2 PCIC Reliability Model"

North American Reliability Council, "NERC Reliability Standards Process Manual"

North American Reliability Council, "The NERC Functional Model - Functions and Relationships for Interconnected Systems Operation and Planning"

SAS Institute, "New Methods for Modeling Reliability Using Degradation Data"

APPENDIX B
DATA COLLECTION LISTINGS

CATEGORY C: Control Equipment

C1-000. Circuit Card Assembly

The following is a listing of the information to collect to aid in the development of reliability metrics for a Circuit Card Assembly:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

C2-000. Computer

The following is a listing of the information to collect to aid in the development of reliability metrics for a Computer:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: PC Workstation or Control System Server
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

C3-000. Control Center, Motor

The following is a listing of the information to collect to aid in the development of reliability metrics for a Motor Control Center:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: motor center / load center
- Ratings:
 - Voltage
 - Current
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

C4-000. Control Panel

The following is a listing of the information to collect to aid in the development of reliability metrics for a Control Panel:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Use: Generator, HVAC/Chillers/AHUs, Switchgear
- Is this control panel for critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Control Panel available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

C5-000. Gauge

The following is a listing of the information to collect to aid in the development of reliability metrics for a Gauge:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- In Service Date
- Parent system
- Type: Fuel (Diesel, Gasoline, or Heating Oil?), Vacuum, Pressure (Hydraulic or Pneumatic?)
- Does this Gauge monitor a critical device?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Gauge available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device been replaced due to failure?

C6-000. Meter

The following is a listing of the information to collect to aid in the development of reliability metrics for a Meter:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Electric, Fuel, or Water
 Digital or Analog
- Does this Meter monitor a critical device?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Meter available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance or calibration is performed and at what interval?
- Has this device been replaced due to failure?

C7-000. Network Hub

The following is a listing of the information to collect to aid in the development of reliability metrics for a Network Hub:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Ethernet or Fiber Optic
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

C8-000. Pressure Control Assembly

The following is a listing of the information to collect to aid in the development of reliability metrics for a Pressure Control Assembly:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Ratings:
 - Maximum Pressure (psi)
 - Accumulator Capacity (gal)
- Is this Pressure Control critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Pressure Control available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

C9-000. Pressure Regulator

The following is a listing of the information to collect to aid in the development of reliability metrics for a Pressure Regulator:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

C10-000. Programmable Logic Controller (PLC)

The following is a listing of the information to collect to aid in the development of reliability metrics for a Programmable Logic Controller (PLC):

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Specifications:
 - Number of Points
 - Number of Instructions
 - Scan Time
 - Data Memory
 - Program Memory
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

C11-000. Remote Terminal Unit (RTU)

The following is a listing of the information to collect to aid in the development of reliability metrics for a Remote Terminal Unit (RTU):

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Specifications:
 - Master or Slave
 - Number of Serial Ports
 - Number of Analog I/O Points
 - Number of Digital I/O Points
 - Memory Size
 - Communication Criteria
 - Serial - RS-232 / 422 / 485
 - 4-20 mA
 - Ethernet
 - LCD Display
 - Programmable Logic Controller (PLC)
 - Radio
 - Telephone
 - Web Enabled
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

C12-000. Control System

The following is a listing of the information to collect to aid in the development of reliability metrics for a Control System:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Number of Acquisition Points
- Architecture: Server based, PLC based, or PC based
- Connections: Fiber Optic or Copper
- A listing of the systems this Control system controls or monitors, identifying critical equipment
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

C13-000. Sending Unit

The following is a listing of the information to collect to aid in the development of reliability metrics for a Sending Unit:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Use: Air Velocity, Pressure, or Temperature
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

C14-000. Thermocouple

The following is a listing of the information to collect to aid in the development of reliability metrics for a Thermocouple:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

C15-000. Thermostat

The following is a listing of the information to collect to aid in the development of reliability metrics for a Thermostat:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Electronic, Millivolt, 24Vac
- Use: Heating or Heating & Cooling
- Is there a battery backup?
- Does this Thermostat control critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Thermostat available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

C16-000. Transducer

The following is a listing of the information to collect to aid in the development of reliability metrics for a Transducer:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Flow, Temperature, Pressure, or Vacuum
- Ratings:
 - Maximum Operating Temperature (°C or °F)
 - Maximum Operating Pressure (psi)
 - Maximum Operating Vacuum (mmHg)
 - Maximum Operating Flow (GPM)
 - Operating Voltage
 - AC (VAC)
 - DC (VDC)
 - Output Voltage
 - AC (VAC)
 - DC (VDC)
- Does this Transducer control critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Transducer available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

C17-000. Valve Operator

The following is a listing of the information to collect to aid in the development of reliability metrics for a Valve Operator:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Electric, Hydraulic, or Pneumatic
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

CATEGORY E: Electrical Power Generation and Distribution Equipment

E1-000. Arrestor, Lightning

The following is a listing of the information to collect to aid in the development of reliability metrics for a Lightning Arrestor:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Ratings:
 - Voltage
 - Discharge current
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E2-000. Battery

The following is a listing of the information to collect to aid in the development of reliability metrics for a Battery:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Date of Manufacture
- In Service Date
- Battery installed in equipment
- Parent system
- Type: Dry Cell (Lithium Ion, Nickel Metal Hydride, Nickel Cadmium); Wet Cell (lead acid, Valve Regulated Lead Acid); or Gel Cell
- Ratings:
 - Voltage
 - Ampere Hour
- Battery Purpose: Backup; Constant Power; Load
- Does the battery supply power to a critical function?
- Is there a charger in use? If so what is the manufacturer and what are the voltage and current ratings? Is the charger used for more than a single battery? If so, how many?
- What is the time to 80% discharge at operational load?
- Is there a spare on site for this device? If so, How Many?
- What periodic maintenance is performed and at what interval?
- Are records kept on maintenance and replacement? Are they written or computerized?
- Has this device or any components been replaced due to failure?
- At what interval is the battery replaced?

E3-000. Bus Duct, All Types

The following is a listing of the information to collect to aid in the development of reliability metrics for Bus Duct:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Length?
- Ratings:
 - Voltage
 - Current
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E4-000. Cabinet Heater

The following is a listing of the information to collect to aid in the development of reliability metrics for a Forced Air Flow Cabinet Heater:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Electric, Steam, or Hot Water
- Electrical:
 - Supply Voltage
 - Current
 - Phase
 - Frequency
 - Watts
- Steam or Hot Water:
 - Connection sizes (in)
 - Pressures (psi)
 - Heat Capacity (BTU)
- Is this a critical device?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Cabinet Heater available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E5-000. Cable Connection

The following is a listing of the information to collect to aid in the development of reliability metrics for a Cable Connection:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- In Service Date
- Parent system
- Ratings:
 - Voltage
 - Current
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E6-000. Cable, AC

The following is a listing of the information to collect to aid in the development of reliability metrics for AC Cable:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- In Service Date
- Ratings:
 - Current
 - Size (MCM)
 - Voltage
 - Operational Load %kVA (If Known)
- Is the conductor: Below Ground, Above Ground, In conduit, In tray, Insulated, Open wire
- Type of insulation?
- Length (feet)
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant loop available for this circuit?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E7-000. Cable, Aerial

The following is a listing of the information to collect to aid in the development of reliability metrics for Aerial Cable:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- In Service Date
- Ratings:
 - Current
 - Size (MCM)
 - Voltage
 - Operational Load %kVA (If Known)
- Type of Insulation
- Length (feet)
- What is the approximate time to replace this device?
- Is there a redundant loop available for this circuit?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E8-000. Cable, DC

The following is a listing of the information to collect to aid in the development of reliability metrics for DC Cable:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- In Service Date
- Ratings:
 - Current
 - Size (MCM)
 - Voltage
 - Operational Load %kVA (If Known)
- Is the conductor: Below Ground, Above Ground, In conduit, In tray, Insulated, Open wire
- Type of insulation?
- Length (feet)
- What is the approximate time to replace this device?
- Is there a redundant loop available for this circuit?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E9-000. Cable, Communication

The following is a listing of the information to collect to aid in the development of reliability metrics for Communication Cable:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- In Service Date
- Type: Serial or Ethernet
- Speed (Mbps)
- Construction (Cat 3, Cat 5, Cat 6, Coaxial, Fiber Optic, Twisted Pair)
- Is the conductor: Below Ground, Above Ground, In conduit, In tray, Insulated, Open wire
- Type of insulation
- Length (feet)
- What is the approximate time to replace this device?
- Is there a redundant loop available for this circuit?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E10-000. Capacitor/Capacitor Bank

The following is a listing of the information to collect to aid in the development of reliability metrics for a Capacitor/Capacitor Bank:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- In Service Date
- Parent system
- Ratings:
 - kVAR
 - Capacitive
 - Inductive
 - Resistive
 - Voltage
 - Frequency
- Cooling: Air, Forced Air, Water, Other – Coolant Name?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available for this capacitor?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E11-000. Charger, Battery

The following is a listing of the information to collect to aid in the development of reliability metrics for a Battery Charger:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Date of Manufacture
- In Service Date
- Serial Number
- Parent system
- Ratings:
 - Input Voltage
 - Output Voltage
 - Output Ampere
- Is this device critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E12-000. Circuit Breaker

The following is a listing of the information to collect to aid in the development of reliability metrics for a Circuit Breaker:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- In Service Date
- Parent system
- Type: Fixed, Metal Clad, Molded Case, Oil filled, SF6 Filled, Vacuum
- Is this circuit breaker normally open or normally closed?
- Ratings:
 - Voltage
 - Current
 - Number of Poles
 - Interrupting Capacity
 - Frame Size
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant circuit?
- Is critical equipment protected by this circuit breaker?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device been replaced?

E13-000. Distribution Panel

The following is a listing of the information to collect to aid in the development of reliability metrics for a Distribution Panel:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Ratings:
 - Voltage
 - Current
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E14-000. Drive

The following is a listing of the information to collect to aid in the development of reliability metrics for a Drive:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: adjustable speed or variable frequency
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E15-000. Engine

The following is a listing of the information to collect to aid in the development of reliability metrics for an Engine:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Diesel or Gasoline
- Number of Cylinders: 4, 6, 8, 12
- Displacement: CI or CC
- Ratings:
 - Horsepower (hp)
 - Torque (ft-lb)
 - Weight (lb)
 - RPM
- Starter type: Electric, Compressed Air, Other
- Is this Engine a critical device?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Engine available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E16-000. Filter, Electrical

The following is a listing of the information to collect to aid in the development of reliability metrics for an Electrical Filter:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Use: Tempest, HEMP
- Ratings:
 - Voltage
 - Current
- Is this Filter connected to critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Filter available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E17-000. Fuse

The following is a listing of the information to collect to aid in the development of reliability metrics for a Fuse:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- In Service Date
- Type: Fast Acting, Slow-Blow, Time Delay
- Ratings:
 - Voltage
 - Interrupting Capacity
- Is critical equipment protected by this Fuse? If so, what critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Fuse available for this circuit?
- Are records kept on fuse replacement? Are they written or computerized?
- What replacement has been done and at what interval?

E18-000. Generator, Diesel Engine

The following is a listing of the information to collect to aid in the development of reliability metrics for a Diesel Engine Generator:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Assembly Manufacturer
- Assembly Model
- Assembly Serial Number
- Assembly In Service Date
- Engine Manufacturer
- Engine Model
- Engine Serial Number
- Engine In Service Date
- Generator Manufacturer
- Generator Model
- Generator Serial Number
- Generator In Service Date
- Purpose: Primary Power or Standby Power?
- Packaged or Unpackaged?
- Ratings:
 - Engine:
 - Number of Cylinders: 4, 6, 8, 12, 16
 - Displacement (CI or CC)
 - Horsepower (hp)
 - Torque (ft-lb)
 - Weight (lb)
 - RPM
 - Starter type: Electric, Compressed Air, Other
 - Generator:
 - kVA/kW
 - Voltage
 - Current
 - Frequency
 - Power Factor
 - Phase
- Is this Generator a critical device?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant generator available?
- Is the redundant Generator brought on line automatically?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E19-000. Generator, Gas Turbine

The following is a listing of the information to collect to aid in the development of reliability metrics for a Gas Turbine Generator:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Assembly Manufacturer
- Assembly Model
- Assembly Serial Number
- Assembly In Service Date
- Engine Manufacturer
- Engine Model
- Engine Serial Number
- Engine In Service Date
- Generator Manufacturer
- Generator Model
- Generator Serial Number
- Generator In Service Date
- Purpose: Primary Power or Standby Power?
- Packaged or Unpackaged?
- Ratings:
 - Engine:
 - Horsepower (hp)
 - Torque (ft-lb)
 - Weight (lb)
 - Turbine Shaft RPM
 - Generator:
 - kVA/kW
 - Voltage
 - Current
 - Frequency
 - Power Factor
 - Phase
- Is this Generator a critical device?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant generator available?
- Is the redundant Generator brought on line automatically?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E20-000. Generator, Hydro Turbine

The following is a listing of the information to collect to aid in the development of reliability metrics for Hydro Turbine Generator:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Assembly Manufacturer
- Assembly Model
- Assembly Serial Number
- Assembly In Service Date
- Engine Manufacturer
- Engine Model
- Engine Serial Number
- Engine In Service Date
- Generator Manufacturer
- Generator Model
- Generator Serial Number
- Generator In Service Date
- Purpose: Primary Power or Standby Power?
- Packaged or Unpackaged?
- Ratings:
 - Horsepower (hp)
 - Torque (ft-lb)
 - Weight (lb)
 - Turbine Shaft RPM
 - Generator:
 - kVA/kW
 - Voltage
 - Current
 - Frequency
 - Power Factor
 - Phase
- Is this Generator a critical device?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant generator available?
- Is the redundant Generator brought on line automatically?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E21-000. Generator, Natural Gas

The following is a listing of the information to collect to aid in the development of reliability metrics for a Natural Gas Generator:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Assembly Manufacturer
- Assembly Model
- Assembly Serial Number
- Assembly In Service Date
- Engine Manufacturer
- Engine Model
- Engine Serial Number
- Engine In Service Date
- Generator Manufacturer
- Generator Model
- Generator Serial Number
- Generator In Service Date
- Purpose: Primary Power or Standby Power?
- Packaged or Unpackaged?
- Ratings:
 - Engine:
 - Number of Cylinders: 4, 6, 8, 12, 16
 - Displacement (CI or CC)
 - Horsepower (hp)
 - Torque (ft-lb)
 - Weight (lb)
 - Starter type: Electric, Compressed Air, Other
 - Turbine Shaft RPM
 - Generator:
 - kVA/kW
 - Voltage
 - Current
 - Frequency
 - Power Factor
 - Phase
- Is this Generator a critical device?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant generator available?
- Is the redundant Generator brought on line automatically?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E22-000. Generator, Steam Turbine

The following is a listing of the information to collect to aid in the development of reliability metrics for a Steam Turbine Generator:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Assembly Manufacturer
- Assembly Model
- Assembly Serial Number
- Assembly In Service Date
- Engine Manufacturer
- Engine Model
- Engine Serial Number
- Engine In Service Date
- Generator Manufacturer
- Generator Model
- Generator Serial Number
- Generator In Service Date
- Purpose: Primary Power or Standby Power?
- Packaged or Unpackaged?
- Ratings:
 - Engine:
 - Horsepower (hp)
 - Torque (ft-lb)
 - Weight (lb)
 - Turbine Shaft RPM
 - Generator:
 - kVA/kW
 - Voltage
 - Current
 - Frequency
 - Power Factor
 - Phase
- Is this Generator a critical device?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant generator available?
- Is the redundant Generator brought on line automatically?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E23-000. Generator, Steam, Heat Recovery

The following is a listing of the information to collect to aid in the development of reliability metrics for a Heat Recovery Steam Generator:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Assembly Manufacturer
- Assembly Model
- Assembly Serial Number
- Assembly In Service Date
- Engine Manufacturer
- Engine Model
- Engine Serial Number
- Engine In Service Date
- Generator Manufacturer
- Generator Model
- Generator Serial Number
- Generator In Service Date
- Purpose: Primary Power or Standby Power?
- Ratings:
 - Horsepower (hp)
 - Torque (ft-lb)
 - Weight (lb)
 - Turbine Shaft RPM
- Generator:
 - kVA/kW
 - Voltage
 - Current
 - Frequency
 - Power Factor
 - Phase
- Is this Generator a critical device?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant generator available?
- Is the redundant Generator brought on line automatically?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E24-000. Heater

The following is a listing of the information to collect to aid in the development of reliability metrics for a Heater:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: lube oil, fuel oil, or jacket water
- Rating:
 - Voltage
 - Current
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E25-000. Inverter, All Types

The following is a listing of the information to collect to aid in the development of reliability metrics for an Inverter:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Purpose: Primary Power or Standby Power
- Ratings:
 - Input Voltage
 - Input Current
 - Output Voltage
 - Output Current
 - kW Output
 - Frequency
 - Waveform
 - Output Overload Protection
 - Output Power Factor
 - Pulse Rating
 - Response Time
 - Battery Protection Levels
- Does this Inverter supply a critical device?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Inverter available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E26-000. Line Conditioner, All Types

The following is a listing of the information to collect to aid in the development of reliability metrics for a Line Conditioner:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Ratings:
 - Voltage
 - Current
 - Power (kW)
 - kVA
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E27-000. Motor Generator Set

The following is a listing of the information to collect to aid in the development of reliability metrics for a Motor Generator Set:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Ratings:
 - Input Voltage
 - Input Current
 - Input Frequency
 - Input Phase
 - Output Voltage
 - Output Current
 - Output Frequency
 - Output Phase
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E28-000. Motor Starter

The following is a listing of the information to collect to aid in the development of reliability metrics for a Motor Starter:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Ratings:
 - Voltage
 - Current
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E29-000. Motor, Electric

The following is a listing of the information to collect to aid in the development of reliability metrics for an Electric Motor:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Ratings:
 - Horsepower
 - Torque (ft-lbs)
 - Speed (RPM)
 - Voltage
 - Phase
 - Current (Amps)
 - Motor NEMA Frame
- Is this Motor critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Motor available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E30-000. Oil Cooler

The following is a listing of the information to collect to aid in the development of reliability metrics for an Oil Cooler:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E31-000. Recloser (Interrupter)

The following is a listing of the information to collect to aid in the development of reliability metrics for a Recloser (Interrupter):

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Electronic or Hydraulic
- Ratings:
 - Voltage
 - Current
 - Number of Operations before Lockout
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E32-000. Rectifier, All Types

The following is a listing of the information to collect to aid in the development of reliability metrics for a Rectifier:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- In Service Date
- Parent system
- Ratings:
 - Input Voltage
 - Input Current
 - Output Voltage
 - Output Current
 - Peak voltage
 - Average forward current
 - Peak surge current
 - Peak forward current
 - Temperature range
- Does this Rectifier supply a critical device?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Rectifier available?
- Is the redundant rectifier automatically switched in line?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E33-000. Relay

The following is a listing of the information to collect to aid in the development of reliability metrics for a Relay:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- In Service Date
- Parent system
- Class: General Purpose, Latching, Impulse, Stepping
Sequence or Differential
- Type: Armature, Hybrid, Solid State, Time Delay, Differential Voltage, Drawout, Overcurrent
- Contact type: Normally Open, Normally Closed
Complex: Number of Poles
- Ratings:
 - Contacts: Voltage, Current
 - Coil: Voltage, Resistance
 - Frequency (Hz)
- Use:
 - Low Level (low current switching, milliamp)
 - Intermediate Level (up to 10 Amps)
 - Protective Relay
 - Special Purpose
- Does this Relay control a critical device? If so what?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Relay available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E34-000. Switch

The following is a listing of the information to collect to aid in the development of reliability metrics for a Switch:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: AC, DC, Automatic Transfer, Manual Transfer, Disconnect – Enclosed, Disconnect – fused, On/Off Breaker Type (non-knife), Float, Oil Filled, Pressure, Vibration, Static, IGBT Technology
- Ratings:
 - Voltage
 - Current
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E35-000. Switchboxes Panels

The following is a listing of the information to collect to aid in the development of reliability metrics for Switchboxes Panels:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- In Service Date
- Parent system
- Type:
 - Disconnect or Transfer?
 - Knife or Circuit Breaker?
 - Manual or Automatic?
- Ratings:
 - Voltage
 - Current
 - Phase
- Does this Switchbox/Panel control critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Switchbox/Panel available?
- Does the Switchbox/Panel provide lock out provisions?
- Does the Switchbox/Panel provide circuit protection?
- Fuse, Circuit Breaker, or Solid State?
- Number of circuits?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E36-000. Switchgear

The following is a listing of the information to collect to aid in the development of reliability metrics for Switchgear:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Bare bus or insulated bus
- Number of Cabinets
- Ratings:
 - Voltage
 - Current
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E37-000. Tank

The following is a listing of the information to collect to aid in the development of reliability metrics for a Tank:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- In Service Date
- Parent system
- Capacity (gal)
- Construction Material
- Type:
 - Fuel: Diesel, Gasoline, Heating Oil, LP, Natural Gas
 - Receiver: Air or Refrigerant - Type: R12, R134A, R22, Other
 - Pressure Rating (psig)
 - Water: Boiler feed, Condensate, Expansion, Water treatment
 - Day: Approximate Running Time (hrs)
- Is there a redundant Tank available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E38-000. Transformer

The following is a listing of the information to collect to aid in the development of reliability metrics for a Transformer:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Dry or Liquid
 - Step up, Step Down, Isolation, or Auto
- Forced Air Flow?
 - Number of Fans
- Ratings:
 - kVA
 - Primary Voltage
 - Primary Current
 - Secondary Voltage
 - Secondary Current
- Number of Taps
- Is this Transformer a critical device?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Transformer available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device been replaced due to failure?

E39-000. UPS: Uninterruptible Power Supply

The following is a listing of the information to collect to aid in the development of reliability metrics for an Uninterruptible Power Supply:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- Manufacturer Date
- In Service Date
- Parent system
- Ratings:
 - kVA
 - Power (kW)
 - Input Voltage
 - Output Voltage
 - Ride Through
- Static Switch type
- What type of equipment is connected to this UPS? Identify critical equipment.
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant UPS available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

E40-000. Voltage Regulator

The following is a listing of the information to collect to aid in the development of reliability metrics for a Voltage Regulator:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- In Service Date
- Parent system
- Ratings:
 - Input Voltage
 - Input Current
 - Output Voltage
 - Output Current
- Does this Voltage Regulator control critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Voltage Regulator available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

CATEGORY H: HVAC Equipment

H1-000. Accumulator

The following is a listing of the information to collect to aid in the development of reliability metrics for a Accumulator:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Capacity (gal or liter)
- Is the Accumulator pressurized? If so, what is the maximum pressure (psi)?
- Is this accumulator critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Accumulator available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H2-000. Air Compressor

The following is a listing of the information to collect to aid in the development of reliability metrics for an Air Compressor:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Electric or Fuel
- Ratings:
 - Pressure (psig)
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H3-000. Air Conditioner

The following is a listing of the information to collect to aid in the development of reliability metrics for an Air Conditioner:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Compressor Type: (Reciprocating or Screw)
- Refrigerant Type: R-12, R-134A, R-22, Other
- Ratings:
 - Cooling Capacity (BTU/hr)
 - Voltage
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H4-000. Air Dryer, All Types

The following is a listing of the information to collect to aid in the development of reliability metrics for an Air Dryer:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent System
- Location
- Types:
 - Refrigerant
 - Desiccant
 - Membrane
 - In-line
- Maximum Pressure
- Pipe Size
- Is this Air Dryer critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Air Dryer available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H5-000. Air Handling Unit

The following is a listing of the information to collect to aid in the development of reliability metrics for a Air Handling Unit:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Nominal cooling capacity (tons)
- Nominal heating capacity (BTU)
- Nominal air volume (CFM)
- Supply Power:
 - Voltage
 - Phase
 - Frequency
- Humidity Control: None, Pan, Spray
- Is there an air filter?
- Evaporator Type
- Coil:
 - Face Area
 - Rows/fins
 - Operating charge (kg)
 - Chilled water or Refrigerant: R12, R134A, R22
- Fan:
 - Diameter (in)
 - Air volume (CFM)
 - Motor HP
 - Motor RPM
- Is this Air Handling Unit critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Air Handling Unit available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H6-000. Air Separator, All Types

The following is a listing of the information to collect to aid in the development of reliability metrics for an Air Separator:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Types:
 - Screening - Drum / Rotary Sifter
 - Screening - Rectangular Deck
 - Screening - Round Deck
 - Air Classifier / Cyclone
 - Magnetic Separator
 - Trommel / Sorter
 - Water / Hydraulic Classifier
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H7-000. Blower

The following is a listing of the information to collect to aid in the development of reliability metrics for a Blower:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Ratings:
 - Capacity (CFM)
 - Maximum RPM
 - Voltage
 - Current
- Is this Blower critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Blower available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H8-000. Boiler

The following is a listing of the information to collect to aid in the development of reliability metrics for a Boiler:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Type: Hot Water, Low Pressure Steam, or High Pressure Steam
- Fuel: Natural Gas, LP Gas, Oil, Diesel, Other
- Ratings:
 - Heating Size (BTU)
 - Capacity (gal)
 - Pressure (psi)
 - Efficiency (%)
- Pilot light or Electronic Igniter
- Does the system contain zones? If so, how many?
- Does the system contain a pump? If so, how many?
- Zone valve:
 - Manufacturer
 - Model
- Pump:
 - Manufacturer
 - Model
- Expansion Tank:
 - Manufacturer
 - Model
- Does the system contain a pressure safety valve?
- Is this a critical HVAC system?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Boiler available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H9-000. Cabinet Heater/Radiator

The following is a listing of the information to collect to aid in the development of reliability metrics for a Cabinet Heater/Radiator:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Electric, Steam, or Hot Water
- Electrical:
 - Supply Voltage
 - Current
 - Phase
 - Frequency
 - Watts
- Steam or Hot Water:
 - Connection sizes (in)
 - Pressures (psi)
 - Heat Capacity (BTU)
- Is this a critical HVAC system?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Cabinet Heater available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H10-000. Chiller

The following is a listing of the information to collect to aid in the development of reliability metrics for a Chiller:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Capacity (Tons, kW, Kcal/hr)
- Number of compressors
- Compressor motor:
 - Manufacturer
 - Model
 - Horsepower
 - Voltage
 - Motor frame number
- Water flow rate (gpm or Lps)
- Refrigerant Type: R12, R134a, R22, Other
- Refrigerant charge (kg)
- Type: Absorption, Centrifugal, Reciprocating, Rotary, Screw
- Is this a critical HVAC system?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Chiller available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H11-000. Compressor, Refrigerant

The following is a listing of the information to collect to aid in the development of reliability metrics for a Refrigerant Compressor:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Electric, Gasoline, or Diesel
 - Reciprocating, centrifugal, screw
- Ratings:
 - Motor/Engine Horsepower
 - Motor Voltage
 - Motor Current (Amps)
 - Motor Phase
 - Motor Speed (RPM)
 - CFM output
 - Maximum Rated Pressure (psi)
 - Receiver Capacity (gal)
 - Refrigerant volume (cc, L, pt, or qt)
 - Refrigerant Type: R12, R134a, R22, Other
- Is this Compressor critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Compressor available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H12-000. Condenser

The following is a listing of the information to collect to aid in the development of reliability metrics for a Condenser:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Double Tube, Propeller type fans with coils, or Shell and Tube (refrigerant/water or water/water)
- Ratings:
 - Capacity (kW)
 - Fan Diameter (in)
 - Fan Motor Horsepower
 - Fan Motor Speed (RPM)
 - Fan Motor Voltage
 - Fan Motor Phase
 - Fan Motor Current (Amps)
 - Flow Rate (CFM)
 - Refrigerant Volume (cc, L, pt, or qt)
 - Refrigerant Type: R12, R134a, R22, Other
- Is this Condenser critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Condenser available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H13-000. Convector

The following is a listing of the information to collect to aid in the development of reliability metrics for a Convector:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Electric, Steam, or Hot Water
- Ratings:
 - Heat output (BTU or kW)
 - Voltage
 - Phase
 - Current (Amps)
 - Pressure, maximum (psi)
- Is this Convector critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Convector available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device been replaced due to failure?

H14-000. Cooling Tower

The following is a listing of the information to collect to aid in the development of reliability metrics for a Cooling Tower:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Type: Atmospheric or Evaporative
- Number of Fans
- Number of Cells
- Ratings:
 - Flow Rate (gpm)
 - Capacity
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H15-000. Damper Assembly

The following is a listing of the information to collect to aid in the development of reliability metrics for a Damper Assembly:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Electric or Pneumatic
- Ratings:
 - Temperature Range (°C or °F)
 - Duct Size (ft²)
 - Voltage
 - Phase
 - Current
 - Motor NEMA Frame
 - Pressure, Operating (in Hg)
 - Pressure, Maximum (in Hg)
 - Operational Load %kVA (If Known)
- Is this Damper critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Damper available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device been replaced due to failure?

H16-000. Dehumidifier

The following is a listing of the information to collect to aid in the development of reliability metrics for a Dehumidifier:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Ratings:
 - Dehumidification rate
 - Capacity
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H17-000. Direct Fired Furnace

The following is a listing of the information to collect to aid in the development of reliability metrics for a Direct Fired Furnace:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Fuel: Natural Gas, LP Gas, Oil, Other
- Ratings:
 - Heat Output (BTU/hr)
 - Voltage
 - Phase
 - Current
 - Motor NEMA Frame
- Is this Direct Fired Furnace critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Direct Fired Furnace available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H18-000. Evaporator

The following is a listing of the information to collect to aid in the development of reliability metrics for a Evaporator:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Air or Liquid
- Design: Coil or Shell and Tube
- Ratings:
 - Heat Transfer Rate (BTU/hr)
 - Voltage
 - Phase
 - Current (Amps)
 - Motor NEMA Frame
 - Liquid type
 - Liquid Capacity
 - Refrigerant type: R12, R134a, R22, water, Other
- Is this Evaporator unit critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Evaporator available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H19-000. Fan

The following is a listing of the information to collect to aid in the development of reliability metrics for a Fan:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Centrifugal, Propeller/disc, Tube-axial, or Vane-axial
- Ratings:
 - Size (in)
 - Output (CFM)
 - Number of Blades
 - Motor Horsepower
 - Motor Speed
 - Voltage
 - Phase
 - Current
 - Motor NEMA Frame
- Is this Fan critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Fan available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H20-000. Filter, Mechanical

The following is a listing of the information to collect to aid in the development of reliability metrics for a Mechanical Filter:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Use: Air, Lube oil, Fuel oil, or Gasoline
- Ratings:
 - Inlet Size (ID ,in² or ft²)
 - Outlet Size (ID ,in² or ft²)
 - Inlet Pressure, Max (psi)
 - Outlet Pressure, Max (psi)
 - Flow Rate (gpm or CFM)
 - Temperature, Maximum (°C or °F)
 - Filter Element
- Is this Filter connected to critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Filter available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H21-000. Heat Exchanger

The following is a listing of the information to collect to aid in the development of reliability metrics for a Heat Exchanger:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent System
- Type: Steam, Water to Water, Lube Oil, Radiator (Small Tube)
- Ratings:
 - Heat Transfer Rate (BTU/hr)
 - Efficiency (%)
- Is this Heat Exchanger critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Heat Exchanger available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H22-000. Heat Pump

The following is a listing of the information to collect to aid in the development of reliability metrics for a Heat Pump:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Ratings:
 - Capacity (Tons)
 - Output (BTU/hr)
 - Voltage
 - Current
- Compressor Type: Reciprocating or screw
- Refrigerant Type: R12, R-134a, R-22, Other
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H23-000. Humidifier

The following is a listing of the information to collect to aid in the development of reliability metrics for a Humidifier:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Capacity
- Type: Liquid to Steam or Steam to Steam
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H24-000. Humistat Assembly

The following is a listing of the information to collect to aid in the development of reliability metrics for a Humistat Assembly:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Ratings:
 - Voltage
 - Current
 - Control Signal
 - Analog Voltage
 - Digital Level
- Is this Humistat critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Humistat available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H25-000. Pipe

The following is a listing of the information to collect to aid in the development of reliability metrics for a Pipe:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- In Service Date
- Parent system
- Size OD (in)
- Size ID (in)
- Length (feet)
- Material/Specification
- Coupling Type:
 - Compression
 - Solder
 - Threaded
- Medium Carried
 - Domestic Hot Water
 - Domestic Cold Water
 - Sanitary Water
 - Coolant
 - Chiller Water
 - Steam
- Is this Pipe critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Pipe loop available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H26-000. Pump

The following is a listing of the information to collect to aid in the development of reliability metrics for a Pump:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Centrifugal or Positive Displacement
- Ratings:
 - Flow Rate (GPM)
 - Maximum Pressure (psi)
 - Maximum Operating Temperature (°C or °F)
 - Motor Horsepower
 - Motor Torque (ft-lbs)
 - Motor Speed (RPM)
 - Motor Voltage
 - Motor Phase
 - Motor Current (Amps)
 - Motor NEMA Frame
- Is this Pump critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Pump available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H27-000. Strainer

The following is a listing of the information to collect to aid in the development of reliability metrics for a Strainer:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Ratings:
 - Inlet Size (in)
 - Outlet Size (in)
 - Maximum inlet pressure (psi)
 - Maximum operating temperature (°C or °F)
- Fluid
 - Coolant
 - Fuel Oil
 - Lube Oil
 - Water
 - Air or Gaseous
- Is this Strainer critical equipment?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Strainer available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H28-000. Valve

The following is a listing of the information to collect to aid in the development of reliability metrics for a Valve:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Diverting, Mixing Ball, Butterfly Check, Control, Expansion, Gate, Globe, Plug, Relief, or Suction?
- Position: Normally Open or Normally Closed
- Control: Manual, Electrical, Pneumatic
- Construction Material
- Ratings:
 - Voltage
 - Current
 - Max Operating Temperature (°C or °F)
 - Max Operating Pressure (psi)
- Size:
 - Inlet Size OD (in)
 - Outlet Size OD (in)
- Is this Valve in a critical system?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant Valve available in the system?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H29-000. Water Cooling Coil

The following is a listing of the information to collect to aid in the development of reliability metrics for a Water Cooling Coil:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

H30-000. Water Heater

The following is a listing of the information to collect to aid in the development of reliability metrics for a Water Heater:

- Today's Date
- Facility Name/ID
- Equipment Facility ID/Name
- Manufacturer
- Model
- Serial Number
- In Service Date
- Parent system
- Type: Electric, Fuel, Gas
- Size
- Is this device critical?
- Is there a spare on site for this device? If so, How Many?
- What is the approximate time to replace this device?
- Is there a redundant device available?
- Are records kept on maintenance and replacement? Are they written or computerized?
- What periodic maintenance is performed and at what interval?
- Has this device or any components been replaced due to failure?

APPENDIX C

NEW PREP ITEM NUMBERS VS. OLD PREP KIND NUMBERS

Table C-1. Power Generation, Distribution, and Electrical Components

Item #	Power Generation, Distribution and Electrical Components	Old Kind #
E1-000	Arrester, Lightning	134
E2-000	Battery	
E2-100	Battery, Rechargeable	
E2-110	Battery, Rechargeable, Gel Cell, Sealed	10
E2-120	Battery, Rechargeable, Lead Acid	11
E2-130	Battery, Rechargeable, Nickel Cadmium	246
E3-000	Bus Duct, All types, Per 100 Ft.	16
E4-000	Cabinet Heater	
E4-100	Cabinet Heater, Forced Air Flow, Steam or Hot Water	17
E5-000	Cable Connection	
E5-100	Cable Connection, Below Ground, Duct, <= 600 V	29
	Cable, AC (Note: Failure Rates will be presented for 1000 foot lengths)	
E6-000	Cable, AC	
E6-100	Cable, AC, 0 to 600 Volts	
E6-110	Cable, AC, 0 to 600 Volts, Above Ground	
E6-111	Cable, AC, 0 to 600 Volts, Above Ground, In Conduit	18
E6-112	Cable, AC, 0 to 600 Volts, Above Ground, In Trays	22
E6-113	Cable, AC, 0 to 600 Volts, Above Ground, No Conduit	20
E6-120	Cable, AC, 0 to 600 Volts, Below Ground	
E6-121	Cable, AC, 0 to 600 Volts, Below Ground, In Duct	35
E6-122	Cable, AC, 0 to 600 Volts, Below Ground, In Conduit	47
E6-123	Cable, AC, 0 to 600 Volts, Below Ground, Insulated	38
E6-200	Cable, AC, 601 to 15K Volts	
E6-210	Cable, AC, 601 to 15K Volts, Above Ground	
E6-211	Cable, AC, 601 to 15K Volts, Above Ground, In Conduit	19
E6-212	Cable, AC, 601 to 15K Volts, Above Ground, In Trays	23
E6-213	Cable, AC, 601 to 15K Volts, Above Ground, In Trays, In Conduit	
E6-214	Cable, AC, 601 to 15K Volts, Above Ground, No Conduit	21
E6-220	Cable, AC, 601 to 15K Volts, Below Ground	
E6-221	Cable, AC, 601 to 15K Volts, Below Ground, In Conduit	48
E6-222	Cable, AC, 601 to 15K Volts, Below Ground, In Duct	36
E6-223	Cable, AC, 601 to 15K Volts, Below Ground, Insulated	46
	Cable, Aerial (Note: Failure Rates will be presented for 1 mile lengths)	
E7-000	Cable, Aerial	
E7-100	Cable, Aerial, 0 to 15K Volts	32
E7-200	Cable, Aerial, >15K Volts	33
	Cable, DC (Note: Failure Rates will be presented for 100 foot lengths)	
E8-000	Cable, DC	
E8-100	Cable, DC, Insulated	49
	Cable, Communication (Note: Failure Rates will be presented for 100 foot lengths)	
E9-000	Cable, Communication	
E9-100	Cable, Communication, Above Ground	
E9-110	Cable, Communication, Above Ground, Coaxial	
E9-120	Cable, Communication, Above Ground, Fiber optic	
E9-130	Cable, Communication, Above Ground, Twisted Pair	

Table C-1. Power Generation, Distribution, and Electrical Components (Cont'd)

Item #	Power Generation, Distribution and Electrical Components	Old Kind #
E9-200	Cable, Communication, Below Ground	
E9-210	Cable, Communication, Below Ground, Coaxial	
E9-220	Cable, Communication, Below Ground, Fiber optic	
E9-230	Cable, Communication, Below Ground, Twisted Pair	
E10-000	Capacitor/Capacitor Bank	54
E11-000	Charger, Battery	9
E12-000	Circuit Breaker	
E12-100	Circuit Breaker, Air	
E12-110	Circuit Breaker, Air, 3-Phase, > 600 Volts, > 600 Amps	
E12-111	Circuit Breaker, Air, 3-Phase, > 600 Volts, > 600 Amps, NC: Normally Closed	
E12-112	Circuit Breaker, Air, 3-Phase, > 600 Volts, > 600 Amps, NO: Normally Open	
E12-200	Circuit Breaker, Fixed (Includes Molded Case)	
E12-210	Circuit Breaker, Fixed (Includes Molded Case), <= 600 V, 3 Phase, <= 600 Amp	
E12-211	Circuit Breaker, Fixed (Includes Molded Case), <= 600 V, 3 Phase, <= 600 Amp, NC: Normally Closed	61
E12-212	Circuit Breaker, Fixed (Includes Molded Case), <= 600 V, 3 Phase, <= 600 Amp, NO: Normally Open	60
E12-220	Circuit Breaker, Fixed (Includes Molded Case), <= 600 V, 3 Phase, > 600 Amp	
E12-221	Circuit Breaker, Fixed (Includes Molded Case), <= 600 V, 3 Phase, > 600 Amp, NC: Normally Closed	63
E12-222	Circuit Breaker, Fixed (Includes Molded Case), <= 600 V, 3 Phase, > 600 Amp, NO: Normally Open	62
E12-300	Circuit Breaker, Fixed (Molded Case)	
E12-310	Circuit Breaker, Fixed (Molded Case), 600 V, Single Phase	
E12-311	Circuit Breaker, Fixed (Molded Case), 600 V, Single Phase, NC: Normally Closed	
E12-312	Circuit Breaker, Fixed (Molded Case), 600 V, Single Phase, NO: Normally Open	
E12-400	Circuit Breaker, Metal Clad (Drawout)	
E12-410	Circuit Breaker, Metal Clad (Drawout), <= 600 V, <= 600 Amp	
E12-411	Circuit Breaker, Metal Clad (Drawout), <= 600 V, <= 600 Amp, NC: Normally Closed	67
E12-412	Circuit Breaker, Metal Clad (Drawout), <= 600 V, <= 600 Amp, NO: Normally Open	66
E12-420	Circuit Breaker, Metal Clad (Drawout), <= 600 V, > 600 Amp	
E12-421	Circuit Breaker, Metal Clad (Drawout), <= 600 V, > 600 Amp, NC: Normally Closed	69
E12-422	Circuit Breaker, Metal Clad (Drawout), <= 600 V, > 600 Amp, NO: Normally Open	68
E12-500	Circuit Breaker, Oil Filled	
E12-510	Circuit Breaker, Oil Filled, >5 KV	
E12-511	Circuit Breaker, Oil Filled, >5 KV, NO: Normally Open	
E12-512	Circuit Breaker, Oil Filled, >5 KV, NC: Normally Closed	
E12-600	Circuit Breaker, SF6 Filled	
E12-610	Circuit Breaker, SF6 Filled, NC: Normally Closed	
E12-611	Circuit Breaker, SF6 Filled, NO: Normally Open	
E12-700	Circuit Breaker, Vacuum	
E12-710	Circuit Breaker, Vacuum, < 15 KV, < 600 Amp	
E12-711	Circuit Breaker, Vacuum, < 15 KV, < 600 Amp, NC: Normally Closed	78
E12-712	Circuit Breaker, Vacuum, < 15 KV, < 600 Amp, NO: Normally Open	79
E12-720	Circuit Breaker, Vacuum, < 15 KV, > 600 Amp	
E12-721	Circuit Breaker, Vacuum, < 15 KV, > 600 Amp, NC: Normally Closed	80
E12-722	Circuit Breaker, Vacuum, < 15 KV, > 600 Amp, NO: Normally Open	81
E12-730	Circuit Breaker, Vacuum, > 15 KV	
E13-000	Distribution Panel	
E13-100	Distribution Panel, <= 225Amps, Circuit Breakers, not included (Wall Mount Unit)	
E13-200	Distribution Panel, > 225Amps, Circuit Breakers, not included (Wall Mount Unit)	

Table C-1. Power Generation, Distribution, and Electrical Components (Cont'd)

Item #	Power Generation, Distribution and Electrical Components	Old Kind #
E14-000	Drive	
E14-100	Drive, Adjustable Speed	138
E14-120	Drive, Variable Frequency	
E15-000	Engine	
E15-100	Engine, Diesel	142
E15-200	Engine, Gas	143
E16-000	Filter, Electrical	
E16-100	Filter, Electrical, HEMP	
E16-200	Filter, Electrical, Tempest	113
E17-000	Fuse	
E17-100	Fuse, 0-5 KV	115
E17-200	Fuse, >5 KV to <= 15 KV	116
E18-000	Generator, Diesel Engine	
E18-100	Generator, Diesel Engine, Packaged	
E18-110	Generator, Diesel Engine, Packaged, < 250 KW	
E18-111	Generator, Diesel Engine, Packaged, < 250 KW, Continuous	
E18-112	Generator, Diesel Engine, Packaged, < 250 KW, Standby	
E18-120	Generator, Diesel Engine, Packaged, 250 KW - 1.5 MW	
E18-121	Generator, Diesel Engine, Packaged, 250 KW - 1.5 MW, Continuous	99
E18-122	Generator, Diesel Engine, Packaged, 250 KW - 1.5 MW, Standby	98
E18-200	Generator, Diesel Engine, Unpackaged	
E18-210	Generator, Diesel Engine, Unpackaged, 750 KW - 7 MW	
E18-211	Generator, Diesel Engine, Unpackaged, 750 KW - 7 MW, Continuous	101
E18-212	Generator, Diesel Engine, Unpackaged, 750 KW - 7 MW, Standby	100
E19-000	Generator, Gas Turbine	
E19-100	Generator, Gas Turbine, Packaged	
E19-110	Generator, Gas Turbine, Packaged, 750 KW - 7 MW	
E19-111	Generator, Gas Turbine, Packaged, 750 KW - 7 MW, Continuous	119
E19-112	Generator, Gas Turbine, Packaged, 750 KW - 7 MW, Standby	118
E19-200	Generator, Gas Turbine, Unpackaged	
E19-210	Generator, Gas Turbine, Unpackaged, 750 KW - 7 MW	
E19-211	Generator, Gas Turbine, Unpackaged, 750 KW - 7 MW, Continuous	121
E19-212	Generator, Gas Turbine, Unpackaged, 750 KW - 7 MW, Standby	
E20-000	Generator, Hydro Turbine	
E21-000	Generator, Natural Gas	
E21-100	Generator, Natural Gas, <250 KW	
E21-110	Generator, Natural Gas, <250 KW, Continuous	
E21-120	Generator, Natural Gas, <250 KW, Standby	
E21-200	Generator, Natural Gas, >= 250 KW	
E21-210	Generator, Natural Gas, >= 250 KW, Continuous	
E21-220	Generator, Natural Gas, >= 250 KW, Standby	
E22-000	Generator, Steam Turbine	
E23-000	Generator, Steam, Heat Recovery	
E24-000	Heater	
E24-100	Heater, Lube/Fuel Oil or Jacket Water	
E24-110	Heater, Lube/Fuel Oil or Jacket Water, Electric	126
E25-000	Inverter, All Types	131
E26-000	Line Conditioner, All Types	
E27-000	Motor Generator Set	
E27-100	Motor Generator Set, 3 Phase	

Table C-1. Power Generation, Distribution, and Electrical Components (Cont'd)

Item #	Power Generation, Distribution and Electrical Components	Old Kind #
E27-110	Motor Generator Set, 3 Phase, 60 Hz	147
E27-120	Motor Generator Set, 3 Phase, 400 Hz	144
E28-000	Motor Starter	
E28-100	Motor Starter, <= 600 V	150
E28-200	Motor Starter, > 600 V	151
E29-000	Motor, Electric	
E29-100	Motor, Electric, DC	141
E29-200	Motor, Electric, Induction	
E29-210	Motor, Electric, Induction, <= 600 V	148
E29-220	Motor, Electric, Induction, > 600 V	149
E29-300	Motor, Electric, Single Phase	
E29-310	Motor, Electric, Single Phase, <= 5 Amp	139
E29-320	Motor, Electric, Single Phase, > 5 Amp	140
E29-400	Motor, Electric, Synchronous	
E29-410	Motor, Electric, Synchronous, <= 600 V	152
E29-420	Motor, Electric, Synchronous, > 600 V	153
E30-000	Oil Cooler	
E31-000	Recloser (Interrupter)	
E31-099	Recloser (Interrupter), Undefined type	
E31-100	Recloser (Interrupter), Electronic	
E31-200	Recloser (Interrupter), Hydraulic	
E32-000	Rectifier, All Types	168
E33-000	Relay	
E33-100	Relay, Electromechanical	
E33-110	Relay, Electromechanical, Differential, Differential Voltage	
E33-120	Relay, Electromechanical, Drawout	
E33-130	Relay, Electromechanical, Overcurrent	
E34-000	Switch	
E34-100	Switch, Automatic Transfer	
E34-110	Switch, Automatic Transfer, <= 600V, > 600 Amp	183
E34-120	Switch, Automatic Transfer, <= 600V, 0-600 Amp	182
E34-200	Switch, Disconnect	
E34-210	Switch, Disconnect, Enclosed	
E34-211	Switch, Disconnect, Enclosed, <= 600V	185
E34-212	Switch, Disconnect, Enclosed, > 600 V to <= 5 KV	186
E34-213	Switch, Disconnect, Enclosed, > 5 KV	187
E34-220	Switch, Disconnect, Fused, DC	
E34-221	Switch, Disconnect, Fused, DC, <= 600 Amp; <= 600V	64
E34-222	Switch, Disconnect, Fused, DC, > 600 Amp; <= 600V	65
E34-300	Switch, Electric, On/Off Breaker Type, Non-knife	
E34-310	Switch, Electric, On/Off Breaker Type, Non-knife, <= 600V	184
E34-400	Switch, Float, Electric	104
E34-500	Switch, Manual Transfer	
E34-510	Switch, Manual Transfer, <= 600 V, <= 600 Amp	188
E34-520	Switch, Manual Transfer, <= 600 V, > 600 Amp	189
E34-600	Switch, Oil Filled	
E34-610	Switch, Oil Filled, >= 5 KV	190
E34-700	Switch, Pressure	
E34-800	Switch, Static	
E34-810	Switch, Static, <= 600 V, 0-600 Amp	210

Table C-1. Power Generation, Distribution, and Electrical Components (Cont'd)

Item #	Power Generation, Distribution and Electrical Components	Old Kind #
E34-820	Switch, Static, <= 600 V, > 600 to <= 1000 Amp	211
E34-830	Switch, Static, <= 600 V, > 1000 Amp	212
E34-840	Switch, Static, Not associated w/UPS unit	
E34-850	Switch, Static, with IGBT Technology	
E34-860	Switch, Static, w/o IGBT Technology	
E34-900	Switch, Vibration	
E35-000	Switchboxes Panels	
E36-000	Switchgear	
E36-100	Switchgear, Bare Bus	
E36-110	Switchgear, Bare Bus, <= 600 V (Circuit Breaker not included)	191
E36-120	Switchgear, Bare Bus, > 600 V to <= 5 KV (Circuit Breaker not included)	192
E36-130	Switchgear, Bare Bus, > 5 KV (Circuit Breaker not included)	193
E36-200	Switchgear, Insulated Bus	
E36-210	Switchgear, Insulated Bus, <= 600 V (Circuit Breaker not included)	194
E36-220	Switchgear, Insulated Bus, > 600 V to <= 5 KV (Circuit Breaker not included)	195
E36-230	Switchgear, Insulated Bus, > 5 KV (Circuit Breaker not included)	196
E36-300	Switchgear, Load Center (Free Standing Unit)	
E37-000	Tank	
E37-100	Tank, Air	
E37-110	Tank, Air, Receiver	167
E37-200	Tank, Liquid	
E37-210	Tank, Liquid, Day, Fuel	198
E37-220	Tank, Liquid, Fuel	197
E37-230	Tank, Liquid, Water	199
E38-000	Transformer	
E38-100	Transformer, Dry	
E38-110	Transformer, Dry, Air Cooled	
E38-111	Transformer, Dry, Air Cooled, <= 500 KVA	202
E38-112	Transformer, Dry, Air Cooled, > 500 KVA to <= 1500 KVA	203
E38-113	Transformer, Dry, Air Cooled, > 1500 KVA to <= 3000 KVA	204
E38-114	Transformer, Dry, Air Cooled, => 3000 KVA to <=5000 KVA	
E38-120	Transformer, Dry, Isolation	
E38-121	Transformer, Dry, Isolation, Delta Wye, < 600 V	132
E38-200	Transformer, Liquid	
E38-210	Transformer, Liquid, Forced Air	
E38-211	Transformer, Liquid, Forced Air, <= 5000 KVA	205
E38-212	Transformer, Liquid, Forced Air, > 5000 KVA to <= 10000 KVA	206
E38-213	Transformer, Liquid, Forced Air, > 10000 KVA to <= 50000 KVA	207
E38-220	Transformer, Liquid, Non-Forced Air	
E38-221	Transformer, Liquid, Non-Forced Air, <= 3000 KVA	208
E38-222	Transformer, Liquid, Non-Forced Air, > 3000 KVA to <= 10000 KVA	209
E38-223	Transformer, Liquid, Non-Forced Air, >10000 KVA to <= 50000 KVA	241
E39-000	UPS: Uninterruptible Power Supply	
E39-100	UPS: Uninterruptible Power Supply, Rotary	213
E39-200	UPS: Uninterruptible Power Supply, Small Computer Room Floor	216
E39-300	UPS: Uninterruptible Power Supply, Solid State	
E39-310	UPS: Uninterruptible Power Supply, Solid State, 60HZ/Module	
E39-320	UPS: Uninterruptible Power Supply, Solid State, with IGBT Technology	
E40-000	Voltage Regulator	
E40-100	Voltage Regulator, Static	238

Table C-2. Heating, Ventilation, and Air conditioning (HVAC) Components

Item #	Heating, Ventilation and Air Conditioning (HVAC)	Old Kind #
H1-000	Accumulator	
H1-100	Accumulator, Pressurized	1
H1-200	Accumulator, Unpressurized	2
H2-000	Air Compressor	
H2-100	Air Compressor, Electric	3
H2-200	Air Compressor, Fuel	4
H3-000	Air Conditioner	
H4-000	Air Dryer, All Types	5
H5-000	Air Handling Unit	
H5-100	Air Handling Unit, Humid	
H5-110	Air Handling Unit, Humid, Pan Humid, w/o Drive	
H5-120	Air Handling Unit, Humid, Spray Humid, w/o Drive	
H5-200	Air Handling Unit, Non-Humid	
H5-210	Air Handling Unit, Non-humid, w/o Drive	6
H5-300	Air Handling Unit, Multizone System	
H5-310	Air Handling Unit, Multizone System, Packaged	
H6-000	Air Separator, All Types	
H7-000	Blower	
H7-100	Blower, w/o Drive	12
H8-000	Boiler	
H8-100	Boiler, Hot Water	13
H8-200	Boiler, Steam	
H8-210	Boiler, Steam, High Pressure (> 15 psig)	14
H8-220	Boiler, Steam, Low Pressure (<= 15 psig)	15
H9-000	Cabinet Heater/Radiator	
H10-000	Chiller	
H10-100	Chiller, Absorption	244
H10-200	Chiller, Centrifugal	
H10-210	Chiller, Centrifugal, <= 600 Tons	
H10-220	Chiller, Centrifugal, > 600 <= 1000 Tons	55
H10-230	Chiller, Centrifugal, > 1000 Tons	
H10-300	Chiller, Reciprocating	
H10-310	Chiller, Reciprocating, with Drive	
H10-311	Chiller, Reciprocating, with Drive, <50 Ton	
H10-320	Chiller, Reciprocating, Closed	
H10-321	Chiller, Reciprocating, Closed, with Drive, 50 - 200 Tons	56
H10-330	Chiller, Reciprocating, Open	
H10-331	Chiller, Reciprocating, Open, w/o Drive, 50 - 200 Tons	57
H10-400	Chiller, Rotary	
H10-410	Chiller, Rotary, 600 - 1000 Tons	58
H10-500	Chiller, Screw	
H10-510	Chiller, Screw, <=300 Tons	
H10-520	Chiller, Screw, >300 Tons	59
H11-000	Compressor, Refrigerant	
H11-010	Compressor, Refrigerant, <= 1 Ton	
H11-020	Compressor, Refrigerant, > 1 Ton	84
H11-100	Compressor, Refrigerant, Screw	85
H12-000	Condenser	
H12-100	Condenser, Double Tube	86
H12-200	Condenser, Propeller Type Fans with Coils, DX: Direct Expansion	87

Table C-2. Heating, Ventilation, and Air conditioning (HVAC) Components (Cont'd)

Item #	Heating, Ventilation and Air Conditioning (HVAC)	Old Kind #
H12-300	Condenser, Shell and Tube	88
H13-000	Convactor	
H13-100	Convactor, Fin Tube Baseboard	
H13-110	Convactor, Fin Tube Baseboard, Electric	89
H13-120	Convactor, Fin Tube Baseboard, Steam or Hot Water	90
H14-000	Cooling Tower	
H14-100	Cooling Tower, Atmospheric Type (Without fans with motors and internal lift)	94
H14-200	Cooling Tower, Evaporative Type (Without fans with motors and internal lift pump)	95
H15-000	Damper Assembly	
H15-100	Damper Assembly, Motor Operated	96
H15-200	Damper Assembly, Pneumatically Operated	97
H16-000	Dehumidifier	
H16-100	Dehumidifier, >10 lb/hr	
H17-000	Direct fired furnace	
H17-100	Direct fired furnace, <=500 MB/h	
H17-200	Direct fired furnace, >500 MB/h	
H18-000	Evaporator	
H18-100	Evaporator, Direct Expansion	
H18-110	Evaporator, Direct Expansion, Coil	82
H18-120	Evaporator, Direct Expansion, Shell Tube	174
H19-000	Fan	
H19-100	Fan, Centrifugal	106
H19-200	Fan, Propeller/Disc	107
H19-300	Fan, Tube axial	108
H19-400	Fan, Vane axial	109
H20-000	Filter, Mechanical	
H20-100	Filter, Mechanical, Air Regulator Set	110
H20-200	Filter, Mechanical, Fuel Oil	112
H20-300	Filter, Mechanical, Lube Oil	111
H21-000	Heat Exchanger	
H21-100	Heat Exchanger, Boiler System, Steam	123
H21-200	Heat Exchanger, Lube Oil	125
H21-300	Heat Exchanger, Radiator	
H21-310	Heat Exchanger, Radiator, Small Tube	166
H21-400	Heat Exchanger, Water to Water	124
H22-000	Heat Pump	
H23-000	Humidifier	
H24-000	Humistat Assembly	127
H25-000	Pipe	
H25-100	Pipe, Flex	
H25-110	Pipe, Flex, Non-Reinforced	
H25-111	Pipe, Flex, Non-Reinforced, < 4 Inch	
H25-112	Pipe, Flex, Non-Reinforced, > 4 Inch	51
H25-120	Pipe, Flex, Reinforced	
H25-121	Pipe, Flex, Reinforced, < 4 Inch	
H25-122	Pipe, Flex, Reinforced, > 4 Inch	53
H25-200	Pipe, Pneumatic	
H25-300	Pipe, Refrigerant	
H25-310	Pipe, Refrigerant, < 1 Inch, Per 100 Ft	91

Table C-2. Heating, Ventilation, and Air conditioning (HVAC) Components (Cont'd)

Item #	Heating, Ventilation and Air Conditioning (HVAC)	Old Kind #
H25-320	Pipe, Refrigerant, 1 to 3 Inch, Per 100 Ft	92,158,159
H25-400	Pipe, Water	
H25-410	Pipe, Water, <= 2 Inch, Per 100 Ft	154
H25-420	Pipe, Water, > 2 to <= 4 Inch, Per 100 Ft	155
H25-430	Pipe, Water, > 4 to <= 8 Inch, Per 100 Ft	156
H25-440	Pipe, Water, > 8 to <= 12 Inch, Per 100 Ft	157
H25-450	Pipe, Water, > 12 Inch, Per 100 Ft	93
H26-000	Pump	
H26-100	Pump, Centrifugal	
H26-110	Pump, Centrifugal, Integral Drive	163
H26-120	Pump, Centrifugal, w/o Drive	164
H26-200	Pump, Positive Displacement	165
H27-000	Strainer	
H27-100	Strainer, Air or Gaseous	
H27-110	Strainer, Air or Gaseous, Air Systems	
H27-200	Strainer, Liquid	
H27-210	Strainer, Liquid, Coolant	177
H27-220	Strainer, Liquid, Duplex Fuel/Lube Oil	180
H27-230	Strainer, Liquid, Fuel Oil	179
H27-240	Strainer, Liquid, Lube Oil	178
H27-250	Strainer, Liquid, Water	
H27-251	Strainer, Liquid, Water, <= 4 Inch	175
H27-252	Strainer, Liquid, Water, > 4 Inch	176
H28-000	Valve	
H28-100	Valve, 3 Way	
H28-110	Valve, 3 Way, Diverting/Sequencing	236
H28-120	Valve, 3 Way, Mixing Control	237
H28-200	Valve, Backflow Preventer	
H28-300	Valve, Ball	
H28-310	Valve, Ball, NC: Normally Closed	217
H28-320	Valve, Ball, NO: Normally Open	218
H28-400	Valve, Butterfly	
H28-410	Valve, Butterfly, NC: Normally Closed	219
H28-420	Valve, Butterfly, NO: Normally Open	220
H28-500	Valve, Check	221
H28-600	Valve, Control	
H28-610	Valve, Control, NC: Normally Closed	223
H28-620	Valve, Control, NO: Normally Open	224
H28-700	Valve, Expansion	105
H28-800	Valve, Gate	
H28-810	Valve, Gate, NC: Normally Closed	225
H28-820	Valve, Gate, NO: Normally Open	226
H28-830	Valve, Gate, Double Flap	
H28-900	Valve, Globe	
H28-910	Valve, Globe, NC: Normally Closed	227
H28-920	Valve, Globe, NO: Normally Open	228
H28-A00	Valve, Plug	
H28-A10	Valve, Plug, NC: Normally Closed	232
H28-A20	Valve, Plug, NO: Normally Open	233
H28-B00	Valve, Reducing	

Table C-2. Heating, Ventilation, and Air conditioning (HVAC) Components (Cont'd)

Item #	Heating, Ventilation and Air Conditioning (HVAC)	Old Kind #
H28-B10	Valve, Reducing, Makeup Water	234
H28-C00	Valve, Relief	235
H28-D00	Valve, Suction	181
H29-000	Water Cooling Coil	
H29-100	Water Cooling Coil, Fan Coil Unit	239
H30-000	Water Heater	
H30-100	Water Heater, Domestic Hot Water	
H30-110	Water Heater, Domestic Hot Water, Electric	
H30-120	Water Heater, Domestic Hot Water, Fuel	
H30-130	Water Heater, Domestic Hot Water, Gas	

Table C-3. Controls and Monitoring Components

Item #	Control and Monitoring	Old Kind #
C1-000	Circuit Card Assembly	
C-100	Circuit Card Assembly, Data I/O Card	
C-110	Circuit Card Assembly, Data I/O Card, Fiber optic	
C2-000	Computer	
C2-100	Computer, PC Workstation	
C2-200	Computer, Control System Server	
C3-000	Control Center	
C3-100	Control Center, Motor/Load Center	
C4-000	Control Panel	
C4-100	Control Panel, Generator, w/o Switchgear	128
C4-200	Control Panel, HVAC/Chillers/AHUs, w/o Switchgear	129
C4-300	Control Panel, Switchgear	130
C5-000	Gauge	
C-510	Gauge, Fluid level	122
C6-000	Meter	
C6-100	Meter, Electric	135
C6-200	Meter, Fuel	136
C6-300	Meter, Water	137
C7-000	Network Hub	
C7-100	Network Hub, Ethernet	
C7-200	Network Hub, Fiber optic	
C8-000	Pressure Control Assembly	160
C9-000	Pressure Regulator	
C9-100	Pressure Regulator, Hot Gas	161
C10-000	Programmable Logic Controller (PLC)	
C11-000	Remote Terminal Unit (RTU)	
C12-000	Control System	
C12-100	Control System, <= 1000 Acquisition Points	169
C12-200	Control System, > 1000 Acquisition Points	170
C13-000	Sending Unit	
C13-100	Sending Unit, Air Velocity	173
C13-200	Sending Unit, Pressure	171
C13-300	Sending Unit, Temperature	172
C14-000	Thermocouple	
C15-000	Thermostat	
C15-100	Thermostat, Radiator	201
C16-000	Transducer	
C16-100	Transducer, Flow	114
C16-200	Transducer, Pressure	162
C16-300	Transducer, Temperature	200
C17-000	Valve Operator	
C17-100	Valve Operator, Electric	229
C17-200	Valve Operator, Hydraulic	230
C17-300	Valve Operator, Pneumatic	231

GLOSSARY

1. Glossary

-A-

AVAILABILITY, INHERENT (A_i): The instantaneous probability that a component will be up. A_i considers only downtime for repair due to failures. No logistics delay time, preventative maintenance, etc. is included.

AVAILABILITY, OPERATIONAL (A_o): A_o is the instantaneous probability that a component will be up but differs from inherent availability in that it includes ALL downtime. Included is downtime for both corrective maintenance and preventative maintenance, including any logistics delay time.

-C-

COMPONENT. A piece of electrical or mechanical equipment viewed as an entity for the purpose of reliability evaluation

CORRECTIVE MAINTENANCE (CM): All actions performed as a result of failure, to restore an item to a specified condition. Corrective maintenance can include any or all of the following steps: Localization, Isolation, Disassembly, Interchange, Reassembly, Alignment and Checkout.

-D-

DOWNTIME: That element of time during which an item is in an operational inventory but is not in condition to perform its required function.

-F-

FAILURE (f). The termination of the ability of a component or system to perform a required function.

FAILURE RATE (λ): The mean (arithmetic average, also known as the forced outage rate) number of failures of a component and/or system per unit exposure time. The most common unit in reliability analyses is hours (h). However, some industries use failures per year (f/y) which is denoted by the symbol (λ_y).

-L-

LOGISTIC DELAY TIME: That element of downtime during which no maintenance is being accomplished on the item because of either supply or administrative delay.

-M-

MAINTENANCE: All actions necessary for retaining an item in or restoring it to a specified condition.

MEAN DOWNTIME (MDT). The average downtime caused by preventative and corrective maintenance, including any logistics delay time. This is synonymous with mean time to restore system (MTTRS) as found in some publications.

MEAN TIME BETWEEN FAILURES (MTBF). The mean exposure time between consecutive failures of a component. MTBF is a require measurement used for calculating inherent availability. It can be estimated by dividing the exposure time by the number of failures in that period.

MEAN TIME BETWEEN MAINTENANCE (MTBM). The average time between all maintenance events that cause downtime, both preventative and corrective maintenance, and also includes any associated logistics delay time.

MEAN TIME TO MAINTAIN (MTTM). The average downtime for preventative maintenance. This includes any logistics delay time.

MEAN TIME TO REPAIR (MTTR). The mean time to replace or repair a failed component. Logistics delay time associated with the repair, such as parts acquisitions, crew mobilization, are not included. It can be estimated by dividing the summation of repair times by the number of repairs and, therefore, is practically the average repair time. The most common unit in reliability analyses is hours (h/f).

-P-

PREVENTATIVE MAINTENANCE (PM): All actions performed in an attempt to retain an item in a specified condition. These actions may or may not result in downtime for the component, and may or may not be performed on a fixed interval.

-R-

RELIABILITY (R(t)). The probability that a component can perform its intended function for a specified time interval (t) under stated conditions. This calculation is based on the exponential distribution.

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