Functional Requirements for Advanced Distribution Automation with DER (ADA-DER)

Functional Requirements for Advanced Distribution Automation with DER (ADA-DER)
Advanced Distribution Automation with DER (ADA-DER) Function
Use Case Description[1]

1 Descriptions of Function

All prior work (intellectual property of the company or individual) or proprietary (non-publicly available) work should be so noted.

1.1 Function Name

Name of Function
The function (further referred as Function) is named **Advanced Distribution Automation (ADA) Function**.

1.2 Function ID

IECSA identification number of the function
L-3,L-3.1,L-3.2,L-3.3,L-3.4,L-3.5,L-3.6,L-3.8,L-3.9

1.3 Brief Description

Describe briefly the scope, objectives, and rationale of the Function.

Objective: The objective of Advanced Distribution Automation Function is to enhance the reliability of power system service, power quality, and power system efficiency, by automating the following three processes of distribution operation control: data preparation in near-real-time; optimal decision-making; and the control of distribution operations in coordination with transmission and generation systems operations.
Scope: The AdvancedDistributionAutomationSystem Function performs a) data gathering, along with data consistency checking and correcting; b) integrity checking of the distribution power system model; c) periodic and event-driven system modeling and analysis; d) current and predictive alarming; e) contingency analysis; f) coordinated volt/var optimization: g) fault location, isolation, and service restoration; h) multi-level feeder reconfiguration; i) pre-arming of RAS and coordination of emergency actions in distribution; j) pre-arming of restoration schemes and coordination of restorative actions in distribution, and k) logging and reporting. These processes are performed through direct interfaces with different databases and systems, (EMS, OMS, CIS, MOS, SCADA,

[1] Background information includes prior UCI work

AM/FM/GIS, AMS and WMS), comprehensive near real-time simulations of operating conditions, near real-time predictive optimization, and actual real-time control of distribution operations.
Rationale: By meeting its objectives in near-real time, the Function makes a significant contribution to improving the power system operations through automation, which cannot be achieved using existing operational methods.
Status: The methodology and specification of the Function for current power system conditions have been developed, and prototype (pilot) and system-wide project in several North-American utilities have been implemented by Utility Consulting International and its client utilities prior to the IECSA project.

1.4 Narrative

A complete narrative of the Function from a Domain Expert's point of view, describing what occurs when, why, how, and under what conditions. This will be a separate document, but will act as the basis for identifying the Steps in Section 2.

1.4.1 Overview of ADA Functions

The AdvancedDistributionAutomationSystem Function operates via the following closely coordinated applications:

1.4.1.1 Overview Diagrams

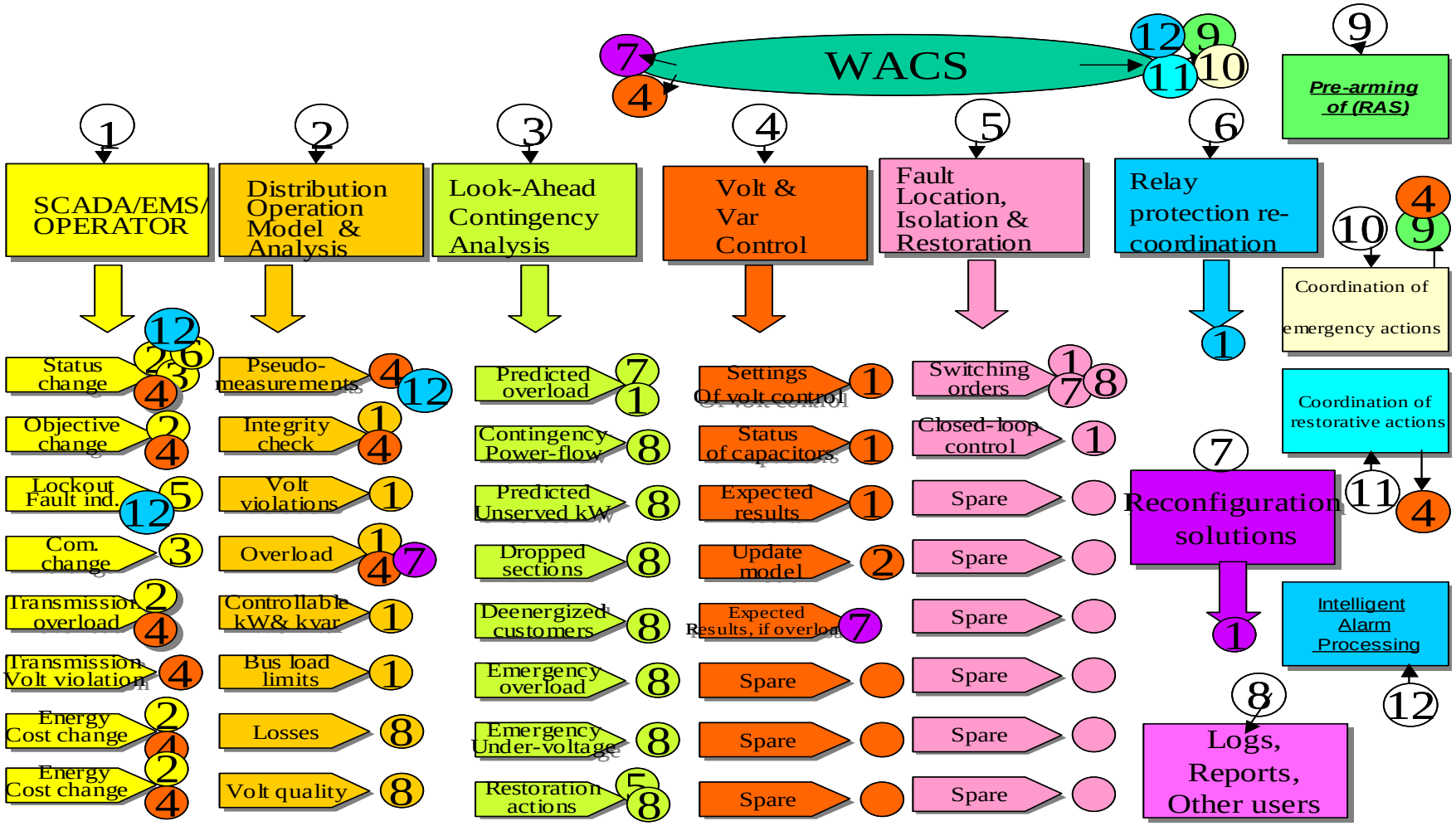


Fig. 1 Coordination of ADA applications is accomplished through internal interfaces within the ADA function and through the feedback from the power system.

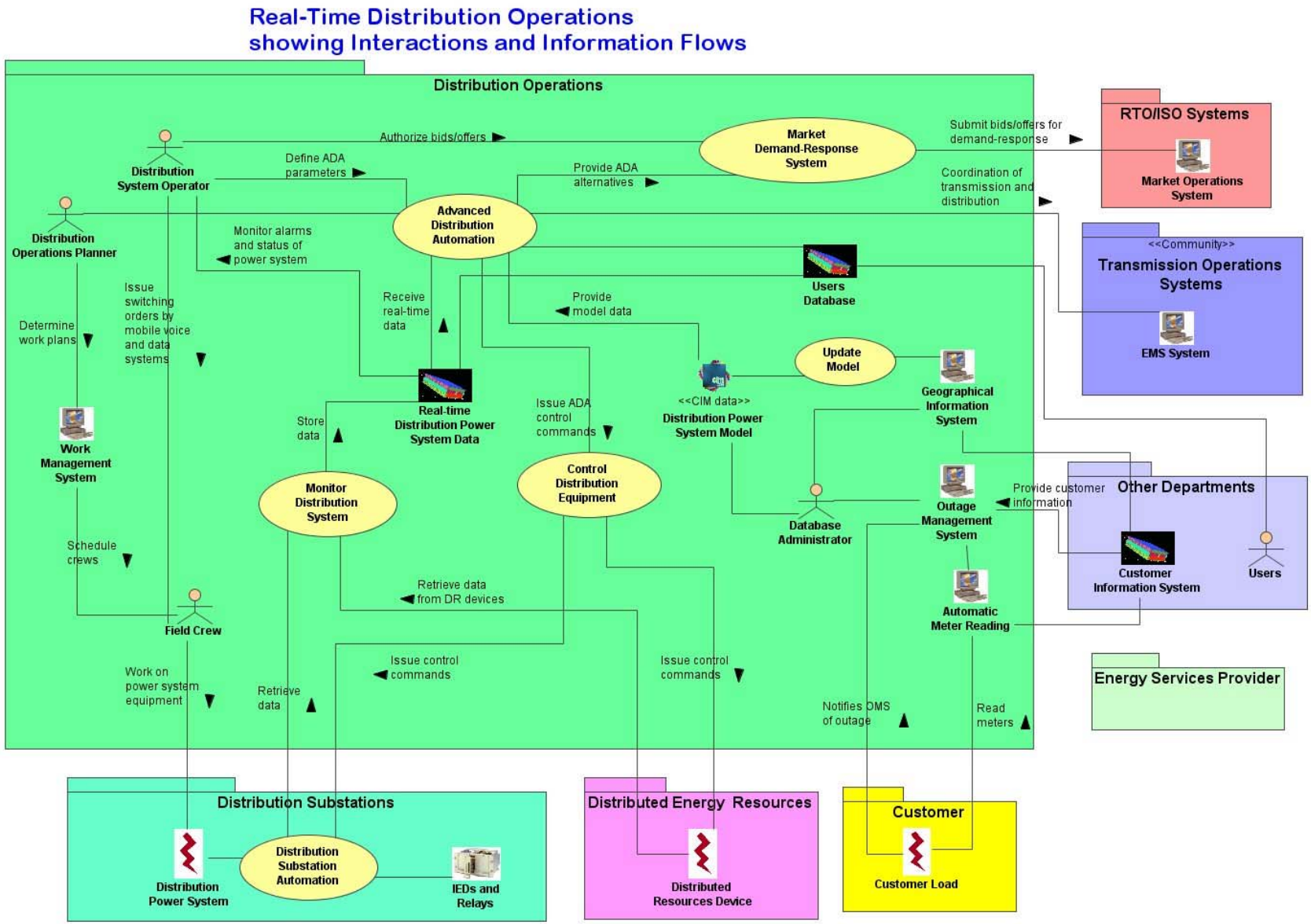


Fig. 2 – {Not yet coordinated with the Use Case description}

1.4.1.2 Overall Preconditions

Actor/System/Contract	*Preconditions or Assumptions*
DistributionSCADASystem	DistributionSCADASystem database is updated via remote monitoring and operator inputs. Required scope, speed, and accuracy of real-time measurements are provided, supervisory and closed-loop control is supported.
AM_FM_GISDatabase	AM/FM system contains the geographical information of the distribution power system circuit connectivity, as well as the parameters describing the power system facilities. Conceptually, the AM_FM_GISDatabase can contain transmission connectivity and facility data and relevant to distribution operations customer-related data.
CIS database	CIS contains load data for customers that is estimated for each nodal location on a feeder, based on billing data and time-of-day and day-of week load shapes for different load categories.
SCADA/EnergyManagementSystem	EnergyManagementSystem system contains the transmission power system model, and can provide the transmission connectivity information for facilities in the vicinity of the distribution power system facilities and with outputs from other EnergyManagementSystem applications
ConversionValidationFunction	The C&V function uses standard interface between AM_FM_GISDatabase and converts and validates information about incremental changes implemented in the field.
ADADistributionOperationModeling and Analysis (DOMA)	**Preconditions:** DistributionSCADASystem with several IEDs along distribution feeders, reporting statuses of remotely controlled switches and analogs including Amps, kW, kvar, and kV. Regional System Operator's ability for updating the SCADA database with statuses of switches not monitored remotely. Substation SCADA with analogs and statuses from CBs exists. EnergyManagementSystem is interfaced with AdvancedDistributionAutomationSystem. AdvancedDistributionAutomationSystem database is updated with the latest AM/FM/GIS/CIS data and operators input. The options for DOMA performance are selected
AdvancedDistributionAutomationSystem: Fault Location Isolation and Service Restoration (FLIR)	Fault Location **Preconditions:** DistributionSCADASystem with fault detectors, Distribution Operation Model and Analysis with fault analysis, fault location relays (schemes) including high impedance relays and Some Distributed Intelligence schemes and Trouble call system exist. Fault Isolation and Service Restoration **Preconditions:** DistributionSCADASystem with ability to control a defined number of switching devices, Fault Location, Distribution Operation Model and Analysis, Voltage and Var Control for adjusting voltage and var after reconfiguration. Supervisory and closed-loop control of switches are available. Some Distributed Intelligence schemes exist. .
AdvancedDistributionAutomationSystem: Contingency Analysis (CA)	The AdvancedDistributionAutomationSystem database is updated including the real-time state of communication with IEDs and the availability of switch control. The options for CA are selected.
AdvancedDistributionAutomationSystem: Multi-level Feeder Reconfiguration (MFR)	**Preconditions:** DistributionSCADASystem with ability to control a definite number of switching devices, Distribution Operation Model and Analysis, Voltage and Var Control for adjusting voltage and var after reconfiguration. Supervisory and closed-loop control of switches are available. The options for the application are selected.
AdvancedDistributionAutomationSystem: Relay Protection Re-coordination (RPR)	The settings and modes of operation of the switching devices are reported by SCADA and can be controlled via SCADA.

Actor/System/Contract	*Preconditions or Assumptions*
ADAVVCController	**Preconditions:** DistributionSCADASystem, Distribution Operation Model and Analysis, capability to monitor and control all or a portion of voltage, capacitor, DER, and power electronic controllers in closed-loop mode exist.
AdvancedDistributionAutomationSystem: Prearming of Remedial Action Schemes (RAS)	**Preconditions**: AdvancedDistributionAutomationSystem is interfaced with the RAS schemes with the capability of changing the priorities of RAS actions and settings
ADAEmergencyCoordinationSystem (CEA)	**Preconditions:** AdvancedDistributionAutomationSystem is interfaced with EnergyManagementSystem and receives critical statuses, measurements, preventive and corrective actions
ADARestorationCoordinationSystem (CRA)	**Preconditions:** AdvancedDistributionAutomationSystem is interfaced with EnergyManagementSystem and receives information about restoration conditions
AdvancedDistributionAutomationSystem: Intelligent Alarm Processing (IAP)	**Preconditions:** AdvancedDistributionAutomationSystem receives synchronized (time stamped) status and analog data from IEDs including uploads from event recorders.
Distributed Intelligence Schemes	**Preconditions:** Distribution Intelligence Schemes are equipped with pear-to-pear communications and interfaced with AdvancedDistributionAutomationSystem for pre-arming and coordination.
LoadManagmentDevice (LMS)	**Preconditions:** LMS is interfaced with AdvancedDistributionAutomationSystem, can be prioritized by AdvancedDistributionAutomationSystem
UFLS: Under-Frequency Load Shedding Schemes	**Preconditions:** UFLS is interfaced with AdvancedDistributionAutomationSystem, can be prioritized and pre-armed by AdvancedDistributionAutomationSystem
UVLS: Under-Voltage Load Shedding Schemes	**Preconditions:** UVLS is interfaced with AdvancedDistributionAutomationSystem, can be prioritized and pre-armed by AdvancedDistributionAutomationSystem
SLS: Special Load Shedding Schemes	**Preconditions:** SLS is interfaced with AdvancedDistributionAutomationSystem, can be prioritized and pre-armed by AdvancedDistributionAutomationSystem

1.4.1.3 Overview of Post Conditions

Actor/Activity	*Post-conditions Description and Results*
SCADA Distribution	Works continuously
ADADistributionOperationModeling and Analysis	All details of the real-time unbalanced distribution power flow are available for engineering review. The operator is provided with the summary of analysis. Other applications receive the pseudo-measurements for each distribution system element down to load centers in the secondaries practically replacing hundreds thousands of measurements. The database is updated via real-time topology data. The observability of distribution operating conditions is increased multifold. The dynamic voltage limits are calculated; aggregated load models for EnergyManagementSystem are provided; dispatchable load is estimated.
AdvancedDistributionAutomation	Faulted section is identified. A solution for an optimal isolation of faulted portions of

Actor/Activity	*Post-conditions Description and Results*
System: Fault Location Isolation and Service Restoration	distribution feeder and restoration of services to healthy portions is provided to the operator; closed-loop execution of switching orders is available; Outage time for the majority of customers is reduced to several minutes.
AdvancedDistributionAutomation System: Contingency Analysis	Results of contingency analysis of the relevant portion of distribution system are provided for engineering review and for use by other applications. Expected overload is determined; solutions are recommended. Planned outages are better prepared.
AdvancedDistributionAutomation System: Multi-level Feeder Reconfiguration	Optimal selection of feeder(s) connectivity for a given objective is provided to the operator; Closed-loop execution is available. Reliability is increased, losses are reduced, voltages are improved; room for voltage optimization is increased; utilization of distribution facilities is enhanced;
AdvancedDistributionAutomation System: Relay Protection Re-coordination	Relay protection settings adjusted to the real-time conditions based on the preset rules are sent to relevant protective relaying. The relay coordination is adaptive to the real-time condition; the reliability of service is increased.
AdvancedDistributionAutomation System: Voltage and Var Control	Optimal voltage controller and DER controller settings and capacitor statuses for a given objective(s) are sent to respective devices. The power quality is enhanced; The distribution facilities are better utilized; the transmission and generation systems is better supported by volt and vars; the load management is less intrusive; the customers pay smaller bills.

1.4.2 Distribution Operation Modeling and Analysis (DOMA)

This application is based on a real-time unbalanced distribution power flow for dynamically changing distribution operating conditions. It analyzes the results of the power flow simulations and provides the operator with the summary of this analysis. It further provides other applications with pseudo-measurements for each distribution system element from within substations down to load centers in the secondaries. The model is kept up-to-date by real-time updates of topology, facilities parameters, load, and relevant components of the transmission system.

The Distribution Operation Modeling and Analysis supports three modes of operation:

1. Real-time mode, which reflects present conditions in the power system.
2. Look-ahead mode, which reflects conditions expected in the near future (from one hour to one week ahead)
3. Study mode, which provides the capability of performing the “what if” studies.

The key sub-functions performed by the application are as follows:

1.4.2.1 Modeling Transmission/Sub-Transmission System Immediately Adjacent to Distribution Circuits

This sub-function provides topology and electrical characteristics of those substation transformers and transmission/sub-transmission portions of the system, where loading and voltage levels significantly depend on the operating conditions of the particular portion of the distribution system. The model also includes substation transformers and transmission/sub-transmission lines with load and voltage limits that should be respected by the application.

1.4.2.2 Modeling Distribution Circuit Connectivity

This sub-function provides a topological model of distribution circuits, starting from the distribution side of the substation transformer and ending at the equivalent load center on the secondary of each distribution transformer. A topological consistency check is performed every time connectivity changes. The model input comes from SCADA/EnergyManagementSystem, DistributionSCADASystem, from field crews, from DISCO operator, from AM/FM/GIS, WorkManagementSystem, and OutageManagementSystem databases, and engineers.

- **Data Management Issues between AM/FM/GIS and AdvancedDistributionAutomationSystem Distribution Connectivity Database**

Standard interfaces between different AM_FM_GISDatabases, data converters, and AdvancedDistributionAutomationSystem database are not developed yet for practical use. The AM_FM_GISDatabases were not designed for real-time operational use. They lack many objects and attributes needed for AdvancedDistributionAutomationSystem. The population of the databases is not supported by an interactive consistency check. The existing extractors of data and the converters into AdvancedDistributionAutomationSystem databases do not determine all data errors. The AdvancedDistributionAutomationSystem applications must conduct additional data consistency checking and data corrections before recommendations and controls are issued. Typically utility do not have established procedures for regular update of the AM_FM_GISDatabases by the operation and maintenance personnel. Therefore many changes implemented in the field remain unnoticed by the databases. Synchronization of the field state with the AdvancedDistributionAutomationSystem database is a challenge in modern utilities.

- **Data Management Issues between CIS and AM/FM/GIS and AdvancedDistributionAutomationSystem Distribution Connectivity Database**

For the AdvancedDistributionAutomationSystem applications, the AM/FM/GIS data must be associated with the corresponding customer information data from the CIS database. This data include billing data and description of the customer specifics, such as rate schedule, customer code, meter number, address, etc. The critical information is the billing data. This data is updated based on metering cycles (typically one month) and is not well synchronized. In order to synchronize billing data an automated meter reading system should be implemented. In order to update the AdvancedDistributionAutomationSystem databases more frequently, which would increase the resolution of AdvancedDistributionAutomationSystem functions to individual distribution transformers and even customers, a high capacity communication system should be introduced to gather the data from hundreds of thousands of meters at the same time. Some of the modern procedures enabled by AutomatedMeterReadingDevice conflict with the needs of AdvancedDistributionAutomationSystem model.An example is the consolidated bills, where the individual load data of distribution transformers located in different sites of the consolidated company becomes unavailable for the external to CIS world.

1.4.2.3 Modeling Distribution Nodal Loads

This sub-function provides characteristics of real and reactive load connected to secondary side of distribution transformer or to primary distribution circuit in case of primary meter customers. These characteristics are sufficient to estimate kW and kvars at a distribution node at any given time and day and include the load shapes and load-to-voltage sensitivities (for real and reactive power) of various load categories. In real-time mode, the nodal loads are balanced with real-time measurements obtained from corresponding primary circuits. A validity check is applied to real-time measurements. The load model input comes from DistributionSCADASystem, from CIS supported by AutomatedMeterReadingDevice and linked with AM/FM/GIS, and weather forecast systems.

1.4.2.4 Modeling Distribution Circuit Facilities

This sub-function models the following distribution circuit facilities:

1. Overhead and underground line segments
2. Switching devices
3. Substation and distribution transformers, including step-down transformers
4. Station and feeder capacitors and their controllers
5. Feeder series reactors
6. Voltage regulators (single- and three-phase) and their controllers
7. LTC's and their controllers
8. Distribution generators and synchronous motors
9. Load equivalents for higher frequency models

All facilities should be modeled with sufficient details to support the required accuracy of Distribution Operation Modeling and Analysis application.

1.4.2.5 Distribution Power Flow

The sub-function models the power flow including the impact of automatically controlled devices (i.e., LTCs, capacitor controllers, voltage regulators), and solves both radial and meshed networks, including those with multiple supply busses (i.e. having Distributed Energy Resources (DER) interconnected to the power system).

1.4.2.6 Evaluation of Transfer Capacity

This sub-function estimates the available bi-directional transfer capacity for each designated tie switch. The determined transfer capacity is such that the loading of a tie switch does not lead to any voltage or current violations along the interconnected feeders.

1.4.2.7 Power Quality Analysis

This sub-function performs the power quality analysis by:

1. Comparing (actual) measured and calculated voltages against the limits
2. Determining the portion of time the voltage or imbalance are outside the limits
3. Determining the amount of energy consumed during various voltage deviations and imbalance
4. Recording the time when voltage violations occur
5. Performing modeling of higher harmonics propagation and resonant conditions based on information available from the sources of harmonic distortion
6. Performing modeling of rapid voltage changes based on information available from the sources of voltage distortion

The sub-function provides the ability to estimate the expected voltage quality parameters during the planned changes in connectivity and reactive power compensation.

1.4.2.8 Loss Analysis

This sub-function bases its analysis on technical losses (e.g., conductor I^2R losses, transformer load and no-load losses, and dielectric losses) calculated for different elements of the distribution system (e.g., per feeder or substation transformer). For the defined area, these losses are accumulated for a given time interval (month, quarter, year, etc.). They are further compared with the difference between the energy input (based on measurements) into the defined area and the total of relevant billed kWh (obtained from the database), normalized to the same time interval. The result of the comparison is an estimate of commercial losses (e.g., metering errors and theft).

1.4.2.9 Fault Analysis

This sub-function calculates three-phase, line-to-line-to-ground and line-to-ground fault currents for each protection zone associated with feeder circuit breakers and field reclosers. The minimum fault current is compared with protection settings while the maximum fault current is compared with interrupting ratings of breakers and reclosers. If the requirements are not met, a message is generated for the operator.

1.4.2.10 Evaluation of Operating Conditions

This sub-function determines the difference between the existing substation bus voltage and the substation bus voltages limits. The sub-function also estimates the available dispatchable real and reactive load obtainable via volt/var control. The operator or other applications can use this information for selective load reduction. The sub-function provides aggregated operational parameters for the transmission buses to be used in transmission operation models.

1.4.3 Fault Location, Isolation and Service Restoration (FLIR)

This application detects the fault, determines the faulted section and the probable location of fault, and recommends an optimal isolation of the faulted portions of the distribution feeder and the procedures for the restoration of services to its healthy portions. The key sub-functions performed by the application are as follows:

1.4.3.1 Fault Location

This sub-function is initiated by SCADA inputs, such as lockouts, fault indications/location, and, also, by inputs from OutageManagementSystem, and, in the future, by inputs from fault-predicting devices. It determines the specific protective device, which has cleared the sustained fault, identifies the de-energized sections, and estimates the probable place of the actual or the expected fault. It distinguishes faults cleared by controllable protective devices from those cleared by fuses, and identifies momentary outages and inrush/cold load pick-up currents.

1.4.3.2 Fault Isolation and Service Restoration

This sub-function supports three modes of operation:

1. Closed-loop mode, in which the sub-function is initiated by the Fault location sub-function. It generates a switching order (i.e., sequence) for the remotely controlled switching devices to isolate the faulted section, and restore service to the non-faulted sections. The switching order is automatically executed via SCADA. .
2. Advisory mode, in which the sub-function is initiated by the Fault location sub-function. It generates a switching order for remotely- and manually-controlled switching devices to isolate the faulted section, and restore service to the non-faulted sections. The switching order is presented to operator for approval and execution
3. Study mode, in which the sub-function is initiated by the user. It analyzes a saved case modified by the user, and generates a switching order under the operating conditions specified by the user.

If during execution, there is change in connectivity, the sub-function interrupts the execution and re-optimizes the solution based on new conditions. If during service restoration, there is another fault, the sub-function runs again considering a new fault scenario. When work is completed, the sub-function is instructed to generate a switching order for restoration of the normal configuration. The generated switching orders are based on considering the availability of remotely controlled switching devices, feeder paralleling, creation of islands supported by distributed energy resources, and on cold-load pickup currents.

1.4.4 Contingency Analysis (CA)

This application performs an N-m contingency analysis in the relevant portion of distribution. The function runs in the following manners:

1. Periodically

2. By event (topology change, load change, availability of control change)
3. Study mode, in which the conditions are defined and the application is started by the user.

The application informs the operator on the status of real-time distribution system reliability.

1.4.5 Multi-level Feeder Reconfiguration (MFR)

This application recommends an optimal selection of feeder(s) connectivity for different objectives. It supports three modes of operation:

1. Closed-loop mode, in which the application is initiated by the Fault Location, Isolation and Service Restoration application, unable to restore service by simple (one-level) load transfer, to determine a switching order for the remotely-controlled switching devices to restore service to the non-faulted sections by using multi-level load transfers. .
2. Advisory mode, in which the application is initiated by SCADA alarms triggered by overloads of substation transformer, segments of distribution circuits, or by DOMA detecting an overload, or by operator who would indicate the objective and the reconfiguration area. In this mode, the application recommends a switching order to the operator.
3. Study mode, in which the application is initiated and the conditions are defined by the user.

The application performs a multi-level feeder reconfiguration to meet one of the following objectives:

a. Optimally restore service to customers utilizing multiple alternative sources. The application meets this objective by operating as part of Fault Location, Isolation and Service Restoration.

b. Optimally unload an overloaded segment. This objective is pursued if the application is triggered by the overload alarm from SCADA, or from the Distribution Operation Modeling and Analysis, or from Contingency analysis. These alarms are generated by overloads of substation transformer or segments of distribution circuits, or by operator demand.

c. Minimize losses

d. Minimize exposure to faults

e. Equalize voltages

The last three objectives are selected by engineer/planner.

1.4.6 Relay Protection Re-coordination (RPR)

This application adjusts the relay protection settings to real-time conditions based on the preset rules. This is accomplished through analysis of relay protection settings and operational mode of switching devices (i.e., whether the switching device is in a switch or in a recloser mode), while considering the real-time connectivity, tagging, and weather conditions. The application is called to perform after feeder reconfiguration, and, in case, when conditions are changed and fuse saving is required.

1.4.7 Voltage and Var Control (VVC)

This application calculates the optimal settings of voltage controller of LTCs, voltage regulators, DERs, power electronic devices, and capacitor statuses optimizing the operations by either following different objectives at different times, or considering conflicting objectives together in a weighted manner.

It supports three modes of operation:

1. Closed-loop mode, in which the application runs either periodically (e.g., every 15 min) or is triggered by an event (i.e., topology or objective change), based on real-time information. The application's recommendations are executed automatically via SCADA control commands.
2. Study mode, in which the application performs "what-if" studies, and provides recommended actions to the operator.
3. Look-ahead mode, in which conditions expected in the near future can be studied (from 1 hour through 1 week) by the operator.

The following objectives, which could be preset for different times of the day and overwritten by operator if need to, are supported by the application:

a. Minimize kWh consumption at voltages beyond given voltage quality limits (i.e., ensure standard voltages at customer terminals)
b. Minimize feeder segment(s) overload
c. Reduce load while respecting given voltage tolerance (normal and emergency)
d. Conserve energy via voltage reduction
e. Reduce or eliminate overload in transmission lines
f. Reduce or eliminate voltage violations on transmission lines
g. Provide reactive power support for transmission/distribution bus
h. Provide spinning reserve support
i. Minimize cost of energy
j. Provide compatible combinations of above objectives

If, during optimization or execution of the solution, the circuit status changes, the application is interrupted and solution is re-optimized. If, during execution, some operations are unsuccessful, solution is re-optimized without involving the malfunctioning devices. If some of the controllable devices are unavailable for remote control, solution does not involve these devices but takes into account their reaction to changes in operating conditions.

1.4.8 Pre-arming of Remedial Action Schemes (RAS)

This application receives pre-arming signals from an upper level of control and changes the settings (tuning parameters) of distribution-side remedial action schemes (RAS), e.g., load-shedding schemes (a component of self-healing grid) or intentional DER islanding.

1.4.9 Coordination of Emergency Actions

This application recognizes the emergency situation based on changes of the operating conditions or on reaction of some RAS to operational changes and coordinates the objectives, modes of operation, and constraints of other AdvancedDistributionAutomationSystem applications. For example, Under-frequency Load Shedding Schemes trigger emergency load reduction mode of volt/var control, or the under-frequency protection of DER triggers the pre-armed intentional islanding.

1.4.10 Coordination of Restorative Actions

This application coordinates the restoration of services after the emergency conditions are eliminated. For example, AdvancedDistributionAutomationSystem changes the order of feeder re-connection based on current customer priorities or inhibits return to normal voltage until there are disconnected feeders.

1.4.11 Intelligent Alarm Processing

This application analyzes SCADA and DOMA-generated alarms and other rapid changes of the operational parameters in distribution and transmission and summarizes the multiple alarms into one massage defining the root cause of the alarms. For example, multiple sudden voltage violations along a distribution feeder and overloads of some feeder segments may be caused by a loss of DER excitation, or successful reclosing of a portion of feeder with loss of significant load may be caused by miss-coordination of the recloser settings and a particular fuse protecting a loaded lateral.

1.5 Actor (Stakeholder) Roles

Describe all the people (their job), systems, databases, organizations, and devices involved in or affected by the Function (e.g. operators, system administrators, technicians, end users, service personnel, executives, SCADA system, real-time database, RTO, RTU, IED, power system). Typically, these actors are logically grouped by organization or functional boundaries or just for collaboration purpose of this use case. We need to identify these groupings and their relevant roles and understand the constituency. The same actor could play different roles in different Functions, but only one role in one Function. If the same actor (e.g. the same person) does play multiple roles in one Function, list these different actor-roles as separate rows.

Grouping (Community)		***Group Description***
Actor Name	***Actor Type (person, device, system etc.)***	***Actor Description***
DisCosOperator		Person in charge of distribution operations during the shift
DistributionSCADASystem		Distribution System Supervisory Control and Data Acquisition

Grouping (Community)		*Group Description*
Actor Name	*Actor Type (person, device, system etc.)*	*Actor Description*
ConversionValidationFunction		The C&V function uses standard interface between AM_FM_GISDatabase and converts and validates information about incremental changes implemented in the field.
ADADataChecker		The ADADataChecker monitors data entered into SCADA database and detects changes. When pre-defined changes are detected, the data checker triggers the ADADispatchingSystem.
ADADispatchingSystem		The ADADispatchingSystem starts corresponding AdvancedDistributionAutomationSystem functions based on pre-defined periodicity and events detected by the ADADataChecker.
ADATopologyUpdateSystem		The ADATopologyUpdateSystem updates the AdvancedDistributionAutomationSystem topology model based on status changes detected by the data checker
ADADistributionOperationModel and Analysis (DOMA)		Calculation and Analysis of power flow/state estimation results
ADAVVCController (VVC)		AdvancedDistributionAutomationSystem Voltage and Var Controller: Coordinated optimal control of voltage and var in distribution for different system-wide objectives
AdvancedDistributionAutomationSystem: Fault location function		Fault detection and location in distribution
AdvancedDistributionAutomationSystem: Fault Isolation and Service Restoration (FLIR)		Isolation of faulted portions of distribution feeders and restoration of services to healthy portions
AdvancedDistributionAutomati		Optimal selection of feeder connectivity for different objectives

Grouping (Community)		*Group Description*
Actor Name	*Actor Type (person, device, system etc.)*	*Actor Description*
onSystem: Feeder Reconfiguration (FR)		
AdvancedDistributionAutomationSystem: Relay protection coordination		Adjustment of relay protection settings and operational modes of switches to provide a coordinated relay protection under real-time configuration
AdvancedDistributionAutomationSystem: Prearming of Remedial Action Schemes (RAS)		Change of RAS settings in anticipation of a probable emergency
ADAEmergencyCoordinationSystem		Change of action priorities during the emergency state of the system
ADARestorationCoordinationSystem		Controlling the priorities of actions during the restorative state of the system
AdvancedDistributionAutomationSystem: Intelligent Alarm Processing		Summarizing multiple alarms into one descriptive message.

Grouping (Community)		*Group Description*
Actor Name	*Actor Type (person, device, system etc.)*	*Actor Description*
LoadManagmentDevice		Controlling cycles of cyclic electric appliances (direct load control-DLC), interruptible and curtainable loads
UFLS: Under-Frequency Load Shedding Schemes		Shedding load based on frequency conditions
UVLS: Under-Voltage Load Shedding Schemes		Shedding load based on voltage conditions
SLS: Special Load Shedding Schemes		Shedding load based on specific operating conditions
OutageManagementSystem		Trouble call processing, troubleshoot crew dispatch
WorkManagementSystem		Maintenance management in distribution
FieldPersonnel		Manual operations of field devices, repair and construction work
FieldDevice		Local intelligence for monitoring and control of automated devices in distribution, communicates with SCADA
Distributed Intelligence Schemes		Distributed Intelligence Schemes (DIS) - Performs operations in a localized distribution area based on local information and on data exchange between members of the group. Can communicate with SCADA.
IEDs of DIS members		IEDs grouped in a Distributed Intelligence Scheme
DEROwner		Maintenance and operations of DERs
TransCOs		Transmission of energy from generation to distribution within distribution-defined constraints/contracts
EnergyManage		Transmission and generation management system providing

Grouping (Community)		*Group Description*
Actor Name	*Actor Type (person, device, system etc.)*	*Actor Description*
mentSystem		AdvancedDistributionAutomationSystem with transmission/generation-related objectives, constraints, and input data
RTO/ISO		Wide-area power system control center providing high-level load management and other signals for DisCos
MarketOperationSystem		Wide-area energy market management system providing high-level market signals for DisCos
Major customers		Major users of DisCo's services according to regulatory and contract rules
CustomerServiceRepresentative		Intermediary entity between DisCos and group of customers
AM_FM_GISDatabase		Repository of distribution system assets, their relationships (connectivity), ownerships, and activities
CustomerInformationSystem		Repository of customer information related to DisCos services
AutomatedMeterReadingDevice		Automated Meter Reading interfaced with CIS and AM_FM_GISDatabases
AssetManagementSystem		Asset Management Systems interfaced with AM/FM/GIS
Remedial Action Scheme		Remedial Action Scheme performs local emergency operations based on local information, pre-armed settings and external signals. Can adapt to the changing local operating conditions.
ADADatabase		ADADatabase contains information on the current connectivity, operational parameters, electrical, economic and other relevant characteristics of the distribution power system
ADAHistoricDatabase		
ADATestDatabase		
Environmental		

Grouping (Community)		*Group Description*
Actor Name	*Actor Type (person, device, system etc.)*	*Actor Description*
daily data collector		
ITPersonnel		
LoadForecaster		
DMS SCADA Database		
Regional System Operator		
Prearming of RAS schemes function		
Fault isolation and service restoration subfunction		
AdvancedDistributionAutomationSystem load management functions		Including ADAVVCController

Replicate this table for each logic group.

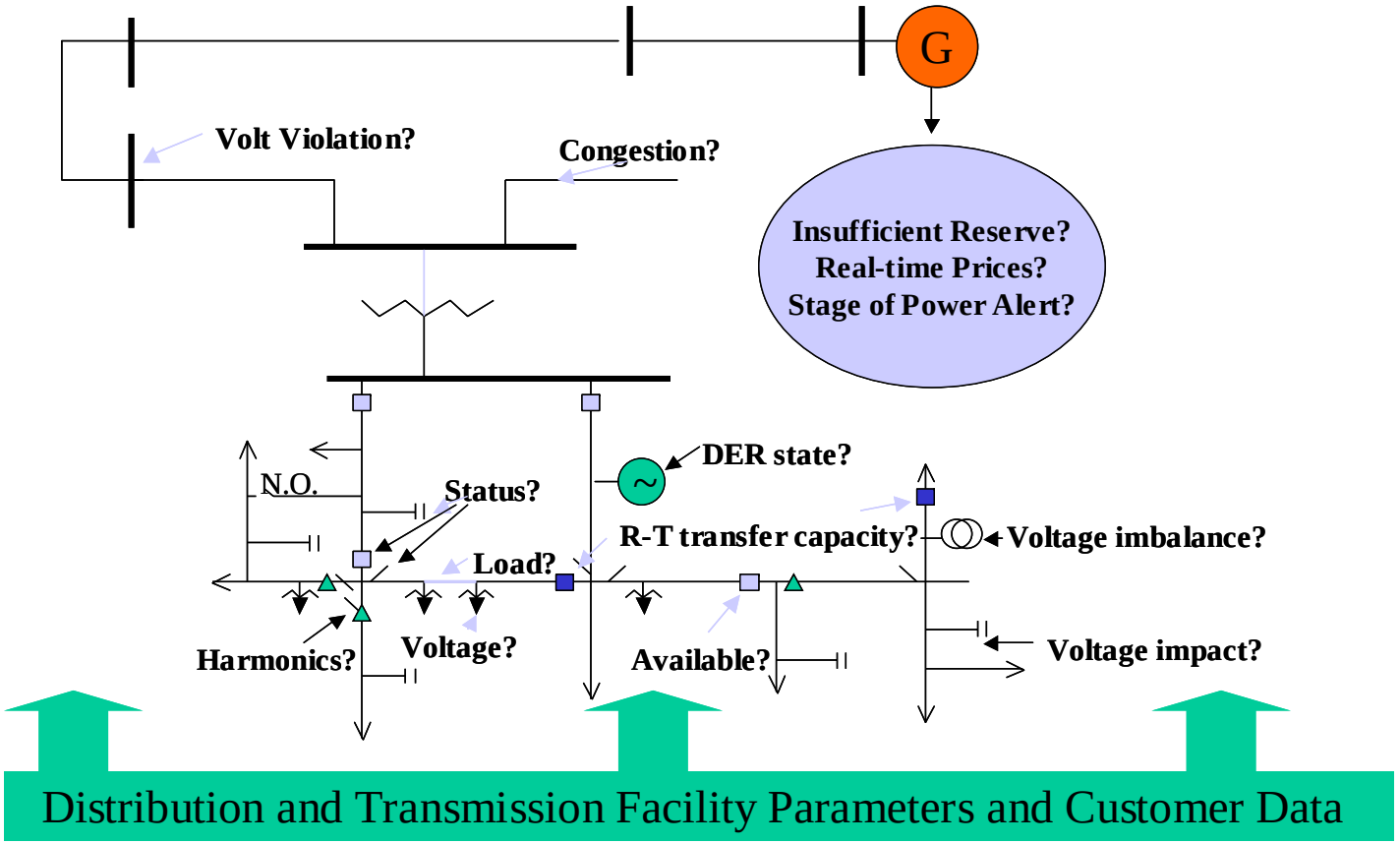
1.6 Information exchanged

Describe any information exchanged in this template.

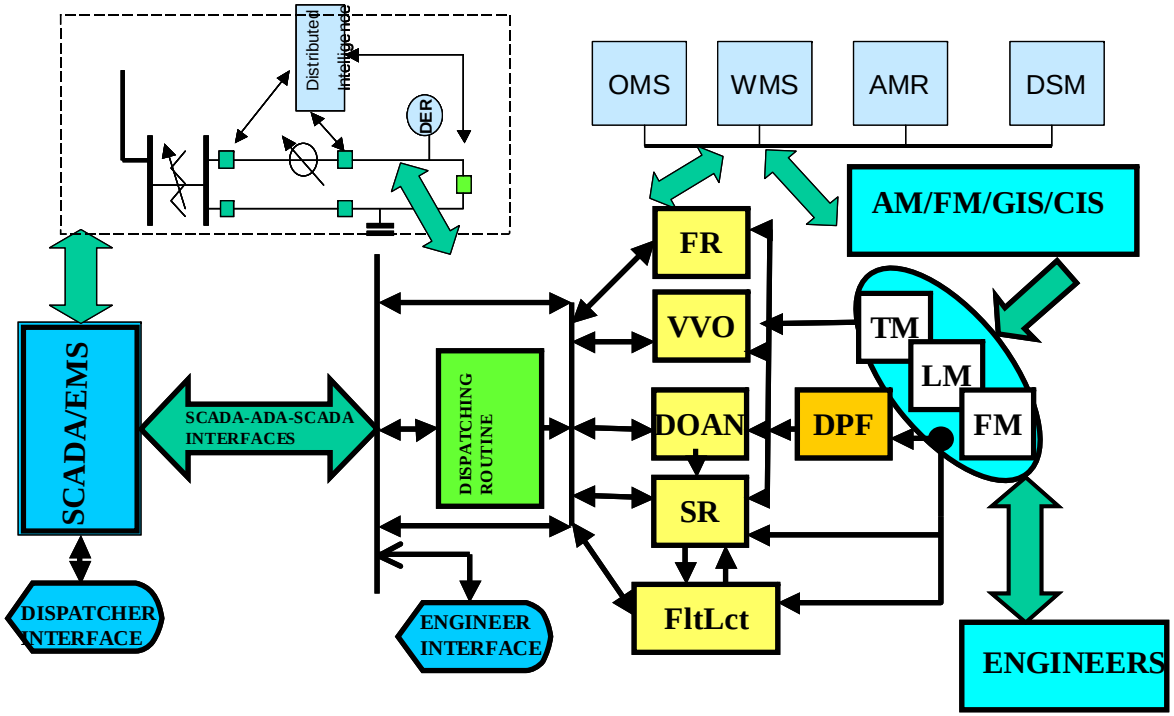
Information Object Name	*Information Object Description*
See individual steps	
AM_FM_GISDatabases	Nominal connectivity, electrical parameters, and geographic locations of distribution and transmission

Information Object Name	*Information Object Description*
	facilities
CIS database	Customer information including billing data, customer types, links to distribution circuits
Outage management system	Trouble call information, crew activity information.
DMS/SCADA database	Real-time data from field IEDs and output of ADAapplications
EnergyManagementSystem/SCADA	Real-time data from transmission field IEDs, output from EnergyManagementSystem applications, information support from AdvancedDistributionAutomationSystem applications
Engineering databases	Planning and design data for future facilities

What Do We Need to Know to Optimally Control Distribution?



ADA INFORMATION FLOW FOR COMPUTING APPLICATIONS



VVO - VOLT/VAR CONTROL; DOAN - DISTRIBUTION OPERATINO ANALYSIS; FltLct- FAULT LOCATION; SR-ISOLATION AND SERVICE RESTORATION; DPF - DISTRIBUTION POWER FLOW; TM - TOPOLOGY MODEL; LM - LOAD MODEL; FM - FACILITY MODELS

1.7 Activities/Services

Describe or list the activities and services involved in this Function (in the context of this Function). An activity or service can be provided by a computer system, a set of applications, or manual procedures. These activities/services should be described at an appropriate level, with the understanding that sub-activities and services should be described if they are important for operational issues, automation needs, and implementation reasons. Other sub-activities/services could be left for later analysis.

Activity/Service Name	*Activities/Services Provided*
DOMA: AdvancedDistributionAutomationSystem updates power system model and analyzes distribution operations	• Update of a) topology model b) facilities model c) load model d) relevant transmission model • Analysis of real-time operating conditions using distribution power flow/state estimation • Evaluation of system transfer capacity based on real-time measurements • Issue of alarming/warning messages to the operator • Generation of distribution operation reports and logs
FLIR: AdvancedDistributionAutomationSystem performs fault location, fault isolation, and service restoration	• AdvancedDistributionAutomationSystem indicates faults cleared by controllable protective devices by distinguishing between: a) faults cleared by fuses b) momentary outages c) inrush/cold load current • AdvancedDistributionAutomationSystem determines the faulted sections based on SCADA fault indications and protection lockout signals • AdvancedDistributionAutomationSystem estimates the probable fault locations based on SCADA fault current measurements and real-time fault analysis • AdvancedDistributionAutomationSystem determines the fault-clearing non-monitored protective device based on trouble call inputs and dynamic connectivity model • AdvancedDistributionAutomationSystem generates switching orders for fault isolation, service restoration, and return to normal (taking into account the availability of remotely controlled switching devices, feeder paralleling, and cold-load pickup): a) Regional System Operator executes switching orders by using SCADA b) Regional System Operator authorizes AdvancedDistributionAutomationSystem application to execute switching orders in closed-loop mode • AdvancedDistributionAutomationSystem isolates the fault and restores service automatically by-passing the operator based on operator's authorization in advance • AdvancedDistributionAutomationSystem pre-arms Distributed Intelligence schemes

Activity/Service Name	*Activities/Services Provided*
	• AdvancedDistributionAutomationSystem considers creation of islands supported by distributed resources for service restoration
MFR: AdvancedDistributionAutomationSystem performs multi-level feeder reconfiguration for different objectives	> Service restoration > Overload elimination > Loss minimization > Voltage balancing > Reliability improvement
RPR: AdvancedDistributionAutomationSystem performs relay protection re-coordination	• AdvancedDistributionAutomationSystem changes relay protection settings and modes of operation of switching devices after feeder reconfiguration • AdvancedDistributionAutomationSystem changes relay protection setting in case of changed conditions for fuse saving
VVC: AdvancedDistributionAutomationSystem optimally controls volt/var by changing the states of voltage controllers, shunts, and distributed resources in a coordinated manner for different objectives under normal and emergency conditions	• Power quality improvement • Overload elimination/reduction • Load management • Transmission operation support in accordance with T&D contracts • Loss minimization in distribution and transmission
CEA: Protection equipment performs system protection actions under emergency conditions	Based on real-time distribution system connectivity, current composition of customers, and signals from an upper level of control, AdvancedDistributionAutomationSystem provides protection system with information needed for properly performing under-frequency and under-voltage load shedding.
IAP: Intelligent alarm processing	Alarms, measurements, and messages produced by SCADA and AdvancedDistributionAutomationSystem are processed by IAP to determine the root cause of the problem and deliver the summary message to the appropriate recipients of this information.
SCADA: system performs disturbance monitoring	• Fault current recording • Fault location • Event recording • Disturbance analysis
Op Dispatch: Operators dispatch field crews to troubleshoot power system and customer power problems	Operators perform emergency switching operations to rapidly restore normal operating conditions by dispatching crews using • Mobile radio system • Mobile computing
LMS: Operators performs intrusive load	• Operators or planners identify critical loads (hospitals, etc.) in advance

Activity/Service Name	*Activities/Services Provided*
management activities	• ADA system locks out load shedding of critical loads • Operators activate direct load control, prioritized by AdvancedDistributionAutomationSystem • Operators activate load curtailment, prioritized by AdvancedDistributionAutomationSystem • Operators apply load interruption, prioritized by AdvancedDistributionAutomationSystem • Operators enable emergency load reduction via AdvancedDistributionAutomationSystem volt/var control • Operators apply manual rolling blackouts
Operators enable emergency (major event) mode of operations for maintenance personnel and major event emergency mode of operation of AdvancedDistributionAutomationSystem	Prepare personnel and automated system for actions under severe emergency conditions.
Outage management systems collect trouble calls, generate outage information, arrange work for troubleshooting	Expedite fault location based on customer call-in information by using dynamic connectivity models
Interactive utility-customer systems inform the customers about the progress of events	• Timely customers update about the progress of service restoration • Automated messaging based on service restoration progress and association of customers' communication nodes with the faulted area
AdvancedDistributionAutomationSystem performs in major event emergency mode	• Automated data preparation, optimal decision making, and control of distribution operations in a coordinated with other systems manner under conditions of major events with more challenging safety and timing requirements • Pre-arming of automatic/automated systems for operations under major event conditions and fast acting fault location, isolation, service restoration, feeder reconfiguration, volt/var control, and operation analysis

1.8 Contracts/Regulations

Identify any overall (human-initiated) contracts, regulations, policies, financial considerations, engineering constraints, pollution constraints, and other environmental quality issues that affect the design and requirements of the Function.

Contract/Regulation	*Impact of Contract/Regulation on Function*
Contract between DISCO and TRANSCO	**Operational boundaries**. If the boundaries are at the circuit breaker level, then AdvancedDistributionAutomationSystem has no direct access to substation capacitors and voltage regulators within the substation fence. In order to execute coordinated Volt/Var control, feeder reconfiguration, service restoration, AdvancedDistributionAutomationSystem needs information about the substation connectivity, substation transformer loading, state of voltage regulators and capacitors, and their controllers. Furthermore,

Contract/Regulation	*Impact of Contract/Regulation on Function*
	AdvancedDistributionAutomationSystem should have capabilities for controlling these devices in a closed-loop mode. If the boundaries are at the high-voltage side of the substation transformer, then AdvancedDistributionAutomationSystem has access to the substation devices and corresponding information. **Volt/Var Agreement.** Defines the voltage limits at the transmission side and reactive power requirements for distribution side. If the contractual parameters are not respected, the Volt/Var application may not meet its objectives, and the voltage limits at the customer side may be violated.
Contracts between DISCO and DEROwner	**Schedules**. Defines amount of kW generated by DER at different times and constraints for power flow at PCC. Deviation from schedules must be timely detected and compensated by other reserve capabilities of the distribution system. **Volt/Var control agreement.** Defines modes of DER operation and setting for Volt/Var control. Defines rules for changes of modes of operation and setting (local/remote, DER/EPS). Deviation from agreement must be timely detected and compensated by other reserve capabilities of the distribution system. **Standard 1547.** Defines rules for interconnection between DER and DISCO (EPS). Deviation from the rules may result in violation of power quality limits, delays in service restoration, damage of DER equipment. Deviation from the standard must be timely detected and remedial actions must be implemented.
Contracts between Disco and Customers	**Standard 519.** Defines power quality requirements at customer terminals. AdvancedDistributionAutomationSystem functions are designed to respect these requirements. AdvancedDistributionAutomationSystem must be capable of monitoring or accurately estimating the power quality parameters at the customer terminals, report and eliminate (or significantly reduce) the violations. **Performance based rates**. Defines the target level of service reliability. The distribution system and the AdvancedDistributionAutomationSystem function should be design to meet the target. **Reliability guarantees.** AdvancedDistributionAutomationSystem function should distinguish the customers with reliability guarantees from those without and focus the service restoration solution on meeting the guarantees, while providing other customers with target service reliability. Load management agreements. Defines the conditions, amount, and frequency of direct load control, load curtailment, interruption, and shedding.

Policy	*From Actor*	*May*	*Shall Not*	*Shall*	*Description (verb)*	*To Actor*

Constraint	*Type*	*Description*	*Applies to*

2 Step by Step Analysis of Function

Describe steps that implement the function. If there is more than one set of steps that are relevant, make a copy of the following section grouping (Preconditions and Assumptions, Steps normal sequence, and Steps alternate or exceptional sequence, Post conditions)

2.1 Distribution Operation Modeling and Analysis (DOMA) Function

Name of this sequence.

2.1.1 DOMA Preconditions and Assumptions

Describe conditions that must exist prior to the initiation of the Function, such as prior state of the actors and activities

Identify any assumptions, such as what systems already exist, what contractual relations exist, and what configurations of systems are probably in place

Identify any initial states of information exchanged in the steps in the next section. For example, if a purchase order is exchanged in an activity, its precondition to the activity might be 'filled in but unapproved'.

Actor/System/Information/Contract	***Preconditions or Assumptions***
AM_FM_GISDatabase	AM/FM database contains the geographical information of the distribution power system circuit connectivity, as well as the parameters describing the power system facilities. Conceptually, the AM_FM_GISDatabase can contain transmission connectivity and facility data and relevant to distribution operations customer-related data.
CIS system (or proxy for CIS data)	CIS contains load data for customers that is estimated for each nodal location on a feeder, based on billing data and time-of-day and day-of week load shapes for different load categories.
EnergyManagementSystem SCADA	EnergyManagementSystem system contains the transmission power system model, and can provide the transmission connectivity information for facilities in the vicinity of the distribution power system facilities and with outputs from other EnergyManagementSystem applications
DMS SCADA database	DistributionSCADASystem database is updated via remote monitoring and operator inputs.. Required scope, speed, and accuracy of real-time measurements are provided, supervisory and closed-loop control is supported.
ConversionValidationFunction	The C&V function extracts incremental changes from AM/FM/GIS/CustomerInformationSystem and converts it into AdvancedDistributionAutomationSystem database format
Environmental daily data collector	Collects environmental data
Regional System Operator	One who makes decisions on operation of the power system
LoadForecaster	Load forecasting system
ADADataChecker	ADADataChecker frequently checks the changes in SCADA database
ADADispatchingSystem	ADADispatchingSystem is designed to coordinate the AdvancedDistributionAutomationSystem functions in a pre-defined manner

Actor/System/Information/Contract	*Preconditions or Assumptions*
ADATopologyUpdateSystem	Checks the topology of the distribution system
ITPersonnel	Field IT support
ADATopologyUpdateSystem	ADATopologyUpdateSystem "reconfigures" connectivity models in seconds
ADATestDatabase	Database containing test data values
ADADistributionOperationModeling and Analysis (DOMA)	**Preconditions:** DistributionSCADASystem with several IEDs along distribution feeders, reporting statuses of remotely controlled switches and analogs including Amps, kW, kvar, and kV. Regional System Operator's ability for updating the SCADA database with statuses of switches not monitored remotely. Substation SCADA with analogs and statuses from CBs exists. EnergyManagementSystem is interfaced with AdvancedDistributionAutomationSystem. AdvancedDistributionAutomationSystem database is updated with the latest AM/FM and CIS data and operators input. The options for DOMA performance are selected

2.1.2 DOMA Steps – Normal Sequence

Describe the normal sequence of events, focusing on steps that identify new types of information or new information exchanges or new interface issues to address. Should the sequence require detailed steps that are also used by other functions, consider creating a new "sub" function, then referring to that "subroutine" in this function. Remember that the focus should be less on the algorithms of the applications and more on the interactions and information flows between "entities", e.g. people, systems, applications, data bases, etc. There should be a direct link between the narrative and these steps.

The numbering of the sequence steps conveys the order and concurrency and iteration of the steps occur. Using a Dewey Decimal scheme, each level of nested procedure call is separated by a dot '.'. Within a level, the sequence number comprises an optional letter and an integer number. The letter specifies a concurrent sequence within the next higher level; all letter sequences are concurrent with other letter sequences. The number specifies the sequencing of messages in a given letter sequence. The absence of a letter is treated as a default 'main sequence' in parallel with the lettered sequences.

Sequence 1:

```
1.1 - Do step 1
1.2A.1 - In parallel to activity 2 B do step 1
1.2A.2 - In parallel to activity 2 B do step 2
1.2B.1 - In parallel to activity 2 A do step 1
1.2B.2 - In parallel to activity 2 A do step 2
1.3 - Do step 3
1.3.1 - nested step 3.1
1.3.2 - nested step 3.2
```

Sequence 2:

2.1 - Do step 1
2.2 – Do step 2

2.1.2.1 Data Conversion and Validation

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
#	*Triggering event: Identify the name of the event.*[2]	*What other actors are primarily responsible for the Process/Activity. Actors are defined in section1.5.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information.Actors are defined in section1.5.*	*What other actors are primarily responsible for Receiving the information Actors are defined in section1.5. (Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*
1.1.1	Data conversion and validation	ADADatabase Administrator, ConversionValidationFunction	Extraction, conversion & validation	ADADatabase Administrator authorizes the Conversion and Validation function to extract, convert and validate circuit connectivity and distribution transformer loading data. This is referred to as Stage 1 validation.	ADADatabase Administrator	ConversionValidationFunction	Authorization to start Stage 1 validation		Intra-Control Center

[2] Note – A triggering event is not necessary if the completion of the prior step leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.1.2		DMS SCADA database, DOMA function	Checking real-time data	The data in the latest download of DMS SCADA data is checked by DOMA function for changes in topology and used to obtain the latest relevant analog data.	DMS SCADA database	DOMA function	DMS real-time analog, status & TLQ data		Intra-Control Center
1.1.3		DOMA function, ADATopologyUpdateSystem	Connectivity change	ADATopologyUpdateSystem prepares changes in connectivity based on the latest DMS SCADA data for updating AdvancedDistributionAutomationSystem database	DOMA function	ADATopologyUpdateSystem	Changes in connectivity		Intra-Control Center
1.1.4		ADATopologyUpdateSystem, ADADatabase	Advanced DistributionAutomationSystem database update	ADATopologyUpdateSystem updates AdvancedDistributionAutomationSystem database	ADATopologyUpdateSystem	ADADatabase	AdvancedDistributionAutomationSystem database update		Intra-Control Center
1.1.5		AM/FM/GIS Database, ConversionValidationFunction	Extraction, conversion & validation	Conversion and Validation function receives initial (before any corrections) connectivity, billing and facility parameter data.	AM_FM_GIS Database	ConversionValidationFunction	Initial connectivity, billing and facility parameter data		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.1.6		ConversionValidationFunction, ADADatabase Administrator	Issuing initial Stage 1 report	After Conversion and Validation function completes Stage 1 analysis it issues a report with incorrect circuit connectivity and transformer loading	ConversionValidationFunction	ADADatabase Administrator	Report with incorrect circuit connectivity and transformer loading		Intra-Control Center
1.1.7		ADADatabase Administrator	Stage 1 corrections	After reviewing the Stage 1 report, the ADADatabase Administrator issues an authorization to perform Stage 1 corrections.	ADADatabase Administrator	ITPersonnel	Authorization to perform Stage 1 corrections		User Interface
1.1.8		ITPersonnel	Stage 1 corrections	AM_FM_GISDatabase is corrected based on the Stage 1 report after ADADatabase Administrator authorized the procedure.	ITPersonnel	AM_FM_GIS Database	Stage 1 corrections		User Interface
1.1.9		AM_FM_GISDatabase, ConversionValidationFunction	Extraction, conversion & validation	Conversion and Validation function receives connectivity, billing and facility parameter data after Stage 1 corrections have been implemented.	AM_FM_GIS Database	ConversionValidationFunction	Connectivity, billing and facility parameter data after Stage 1		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.1.10		ConversionValidationFunction, ADADatabase Administrator	Issuing report requiring no database corrections after Stage 1	After Conversion and Validation function completes Stage 1 analysis it issues a report showing that no further corrections associated with connectivity, billing or facility parameter data are required.	ConversionValidationFunction	ADADatabase Administrator	Report showing that circuit connectivity and transformer loading require no corrections		User Interface
1.1.11		ConversionValidationFunction, ADATestDatabase	Update of AdvancedDistributionAutomationSystem Test Database after Stage 1 corrections	After Stage 1 corrections produce a report with no connectivity and transformer loading problems, the Conversion and Validation function updates the AdvancedDistributionAutomationSystem Test Database which sets the stage for Stage 2 validation.	ConversionValidationFunction	ADATestDatabase	Update of AdvancedDistributionAutomationSystem Test Database		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.1.12		ADADatabase Administrator, ConversionValidationFunction	Load Flow and Load Transfer Analyses	ADADatabase Administrator authorizes the Conversion and Validation function to validate facility parameters via load flow and load transfer analyses. This is referred to as Stage 2 validation.	ADADatabase Administrator	ConversionValidationFunction	Authorization to start Stage 2 validation		Intra-Control Center
1.1.13		ConversionValidationFunction, ADATestDatabase	Load Flow and Load Transfer Analyses	Conversion and Validation function receives excerpts from AdvancedDistributionAutomationSystem Test Database (after they were updated with Stage 1 corrections) to perform Stage 2 analyses.	ADATestDatabase	ConversionValidationFunction	Excerpts from AdvancedDistributionAutomation System Test Database after Stage 1 corrections		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.1.14		ConversionValidationFunction, ADADatabase	Load Flow and Load Transfer Analyses	Conversion and Validation function receives latest statuses and measurements from ADADatabase (which in turn are updated by DMS SCADADatabase) to perform Stage 2 analyses.	ADADatabase	ConversionValidationFunction	Latest statuses and measurements from ADADatabase		Intra-Control Center
1.1.15		ConversionValidationFunction, ADADatabase Administrator	Load Flow and Load Transfer Analyses	After performing Stage 2 analyses, Conversion and Validation function issues a report for ADADatabase Administrator.	ConversionValidationFunction	ADADatabase Administrator	Report on unreasonable load and voltage violations, corresponding facility parameters, results of comparative analyses and correction of inconsistencies		User Interface
1.1.16		ADADatabase Administrator	Stage 2 corrections	After reviewing the Stage 2 report, the ADADatabase Administrator issues an authorization to perform Stage 2 corrections.	ADADatabase Administrator	ITPersonnel	Authorization to perform Stage 2 corrections		User Interface

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.1.17		ADADatabase Administrator, AM/FM/GIS Database	Stage 2 corrections	AM_FM_GISDatabase is corrected based on the Stage 2 report after ADADatabase Administrator authorized the procedure.	ITPersonnel	AM_FM_GIS Database	Stage 2 corrections		User Interface
1.1.18		AM/FM/GIS Database, ConversionValidationFunction	Extraction, conversion & validation	Conversion and Validation function receives connectivity, billing and facility parameter data after Stage 2 corrections have been implemented.	AM_FM_GIS Database	ConversionValidationFunction	Connectivity, billing and facility parameter data after Stage 2		Intra-Control Center
1.1.19		ConversionValidationFunction, ADATestDatabase	Update of Advanced DistributionAutomationSystem Test Database after Stage 2 corrections	The Conversion and Validation function updates the AdvancedDistributionAutomationSystem Test Database.	ConversionValidationFunction	ADATestDatabase	Update of AdvancedDistributionAutomationSystem Test Database		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.1.20		ConversionValidationFunction, ADATestDatabase	Load Flow and Load Transfer Analyses	Conversion and Validation function receives excerpts from AdvancedDistributionAutomationSystem Test Database (after they were updated with Stage 2 corrections) to perform the next round of Stage 2 analyses.	ADATestDatabase	ConversionValidationFunction	Excerpts from AdvancedDistributionAutomationSystem Test Database after Stage 2 corrections		Intra-Control Center
1.1.21		ConversionValidationFunction, ADADatabase	Load Flow and Load Transfer Analyses	Conversion and Validation function receives latest statuses and measurements from ADADatabase (which in turn are updated by DMS SCADADatabase) to perform the next round of Stage 2 analyses.	ADADatabase	ConversionValidationFunction	Latest statuses and measurements from ADADatabase		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.1.22		ConversionValidationFunction, ADADatabase Administrator	Issuing report requiring no database corrections after Stage 2	After Conversion and Validation function completes Stage 2 analysis it issues a report showing that no further corrections associated with unreasonable load and voltage violations, or corresponding facility parameters are required.	ConversionValidationFunction	ADADatabase Administrator	Report showing that no further corrections associated with unreasonable load and voltage violations, or corresponding facility parameters are required.		User Interface
1.1.23		ADADatabase Administrator	Update of ADADatabase	After reviewing the Stage 2 report requiring no further corrections, ADADatabase Administrator authorizes the update of AdvancedDistributionAutomationSystem database.	ADADatabase Administrator	ITPersonnel	Authorization to update AdvancedDistributionAutomationSystem database		User Interface

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.1.24		ITPersonnel, ADATestDatabase	Update of ADADatabase	After permission to update AdvancedDistributionAutomationSystem database is given, ITPersonnel receives the needed update from AdvancedDistributionAutomationSystem Test database.	ADATestDatabase	ITPersonnel	AdvancedDistributionAutomationSystem database update		User Interface
1.1.25		ITPersonnel, ADADatabase	Update of ADADatabase	ITPersonnel updates AdvancedDistributionAutomationSystem database	ITPersonnel	ADADatabase	AdvancedDistributionAutomationSystem database update		User Interface

2.1.2.2 DOMA No Events

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
#	*Triggering event: Identify the name of the event.*[3]	*What other actors are primarily responsible for the Process/Activity. Actors are defined in section1.5.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information.Actors are defined in section1.5.*	*What other actors are primarily responsible for Receiving the information Actors are defined in section1.5. (Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*

[3] Note – A triggering event is not necessary if the completion of the prior step leads to the transition of the following step.

1.2.1	DOMA No Events	DMS SCADA database, DOMA function	Checking real-time data	DOMA function receives the latest scan of DMS SCADA database to be checked for relevant changes or events.	DMS SCADA database	DOMA function	DMS real-time analog, status, TLQ data		Intra-Control Center
1.2.2		EnergyManagementSystem SCADA database, DOMA function	Checking real-time data	DOMA function receives the latest scan of EnergyManagementSystem SCADA database to be checked for relevant changes or events.	EnergyManagementSystem SCADA database	DOMA function	EnergyManagementSystem real-time analog, status, TLQ data		Intra-Control Center
1.2.3		DOMA function	Checking real-time data	DOMA determines that no changes or events are present in SCADA scan.	DOMA function	DOMA function	No changes or events are detected.		Intra-Control Center
1.2.4		DOMA function	DOMA function status verification	DOMA status is verified (on/off) for reporting it to the Regional System Operator.	DOMA function	Regional System Operator	DOMA function status		User Interface

2.1.2.3 DOMA Event Run

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
#	*Triggering event: Identify the name of the event.*[4]	*What other actors are primarily responsible for the Process/Activity. Actors are defined in section1.5.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information.Actors are defined in section1.5.*	*What other actors are primarily responsible for Receiving the information Actors are defined in section1.5. (Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*
1.3.1	DOMA Event Run	DMS SCADA database, DOMA function	Checking real-time data	DOMA function receives the latest scan of DMS SCADA database to be checked for relevant changes or events.	DMS SCADA database	DOMA function	DMS real-time analog, status, TLQ data		Intra-Control Center
1.3.2		EnergyManagementSystem SCADA database, DOMA function	Checking real-time data	DOMA function receives the latest scan of EnergyManagementSystem SCADA database to be checked for relevant changes or events.	EnergyManagementSystem SCADA database	DOMA function	EnergyManagementSystem real-time analog, status, TLQ data		Intra-Control Center

[4] Note – A triggering event is not necessary if the completion of the prior step leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.3.3		DOMA function	Checking real-time data	DOMA, after detecting changes in connectivity, transfers relevant data to ADATopologyUpdateSystem.	DOMA function	ADATopologyUpdateSystem	Changes in connectivity		Intra-Control Center
1.3.4		ADATopologyUpdateSystem, ADADatabase	Advanced DistributionAutomationSystem database update	ADATopologyUpdateSystem updates AdvancedDistributionAutomationSystem database with detected changes in connectivity detected by DOMA function and with latest analog measurements.	ADATopologyUpdateSystem	ADADatabase	Changes in connectivity and latest analog measurements		Intra-Control Center
1.3.5		ADATopologyUpdateSystem, DOMA function	Checking distribution model integrity	ADATopologyUpdateSystem gives permission to DOMA function to analyze the distribution model integrity after AdvancedDistributionAutomationSystem database is updated with latest changes.	ADATopologyUpdateSystem	DOMA function	Permission to analyze distribution model integrity		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.3.6		ADADatabase, DOMA function	Checking distribution model integrity	DOMA function receives the data from AdvancedDistributionAutomationSystem database needed for integrity check.	ADADatabase	DOMA function	Excerpts from AdvancedDistributionAutomationSystem database		Intra-Control Center
1.3.7a		DOMA function	Checking distribution model integrity	The distribution model integrity is confirmed and DOMA gives the permission for performing state estimation and power flow calculations.	DOMA function	DOMA function	Permission for performing state estimation and power flow calculations		Intra-Control Center
1.3.8a		ADADatabase, DOMA function	State estimation and power flow calculations	DOMA function receives the data from AdvancedDistributionAutomationSystem database needed for state estimation and power flow calculations.	ADADatabase	DOMA function	Excerpts from AdvancedDistributionAutomationSystem database		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.3.9a		DOMA function, FLIR function	State estimation and power flow calculations	Upon completion of state estimation and power flow calculations, DOMA function makes the connectivity, facility (including controllers), load and transmission data available to FLIR function.	DOMA function	FLIR function	Connectivity, facility (including controllers), load and transmission data		Intra-Control Center
1.3.10a		DOMA function, ADAVVCController	State estimation and power flow calculations	Upon completion of state estimation and power flow calculations, DOMA function makes the connectivity, facility (including controllers), load and transmission data available to ADAVVCController.	DOMA function	ADAVVCController	Connectivity, facility (including controllers), load and transmission data		Intra-Control Center
1.3.11a		DOMA function	Analysis of distribution state estimation and power flow results	DOMA makes results of power flow calculations available for analysis.	DOMA function	DOMA function	Results of power flow calculations		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.3.12a		DOMA function, ADAHistoricDatabase	Analysis of distribution state estimation and power flow results	DOMA issues a report with results of analysis of state estimation and power flow calculations for storage in historic AdvancedDistributionAutomationSystem database.	DOMA function	ADAHistoric Database	Power flow results, dispatchable kW & kvar, bus voltage limits, customer extreme voltages, segment and xmfr overloads, imbalances, load transfer capacity for selected ties, losses, quality and fault analyses, alarms (if any) about load/voltage violations and from fault analysis, logs		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.3.13a		DOMA function, Regional System Operator	Analysis of distribution state estimation and power flow results	Selected results of analysis of state estimation and power flow calculations are made available for the Regional System Operator, EnergyManagementSystem, and distributed intelligence schemes.	DOMA function	Regional System Operator, EnergyManagementSystem	DOMA function status, dispatchable kW & kvar, bus voltage limits, aggregated load characteristics, transfer capacity, customer extreme voltages and imbalances, alarms (if any) about load/voltage violations and from fault analysis		Intra-Control Center
1.3.14a		DOMA function, ADAVVCController	Analysis of distribution state estimation and power flow results	If analysis of state estimation and power flow calculations detect a voltage or overload violation, VVC is initiated	DOMA function	ADAVVCController	Initiation of VVC		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.3.7b		DOMA function, ADADatabase	Checking distribution model integrity	If checking the distribution model integrity identifies a model inconsistency, a message describing the inconsistency is issued for storage in AdvancedDistributionAutomationSystem database.	DOMA function	ADADatabase	Message describing distribution model inconsistency		Intra-Control Center
1.3.8b		DOMA function, Regional System Operator	Checking distribution model integrity	If checking the distribution model integrity identifies a model inconsistency, a message describing the inconsistency is issued for the Regional System Operator.	DOMA function	Regional System Operator	Message describing distribution model inconsistency		User Interface
1.3.9b		DOMA function, ADAVVCController	Checking distribution model integrity	If checking the distribution model integrity identifies a model inconsistency, a command to switch VVC to default settings is issued.	DOMA function	ADAVVCController	Command to switch ADAVVCController to default settings		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.3.10b		DOMA function, FLIR function	Checking distribution model integrity	If checking the distribution model integrity identifies a model inconsistency, a command to switch FLIR to default settings is issued.	DOMA function	FLIR	Command to switch FLIR to default settings		Intra-Control Center

2.1.2.4 DOMA Scheduled Run

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
#	*Triggering event: Identify the name of the event.*[5]	*What other actors are primarily responsible for the Process/Activity. Actors are defined in section1.5.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information.Actors are defined in section1.5.*	*What other actors are primarily responsible for Receiving the information* *Actors are defined in section1.5.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*
1.4.1	DOMA Scheduled Run	DMS SCADA database, DOMA function	Checking real-time data	DOMA function receives the latest scan of DMS SCADA database to be checked for relevant changes or events.	DMS SCADA database	DOMA function	DMS real-time analog, status, TLQ data		Intra-Control Center

[5] Note – A triggering event is not necessary if the completion of the prior step leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.4.2		EnergyManagementSystem SCADA database, DOMA function	Checking real-time data	DOMA function receives the latest scan of EnergyManagementSystem SCADA database to be checked for relevant changes or events.	EnergyManagementSystem SCADA database	DOMA function	EnergyManagementSystem real-time analog, status, TLQ data		Intra-Control Center
1.4.3		DOMA function	Checking real-time data	DOMA determines that no changes or events are present in SCADA scan.	DOMA function	DOMA function	No changes or events are detected.		Intra-Control Center
1.4.4		ADADatabase, DOMA function	State estimation and power flow calculations	DOMA function receives the data from AdvancedDistributionAutomationSystem database needed for state estimation and power flow calculations.	ADADatabase	DOMA function	Excerpts from AdvancedDistributionAutomationSystem database		Intra-Control Center
1.4.5		DOMA function, FLIR function	State estimation and power flow calculations	Upon completion of state estimation and power flow calculations, DOMA function makes the connectivity, facility (including controllers), load and transmission data available to FLIR function.	DOMA function	FLIR function	Connectivity, facility (including controllers), load and transmission data		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.4.6		DOMA function, ADAVVCController	State estimation and power flow calculations	Upon completion of state estimation and power flow calculations, DOMA function makes the connectivity, facility (including controllers), load and transmission data available to ADAVVCController.	DOMA function	ADAVVCController	Connectivity, facility (including controllers), load and transmission data		Intra-Control Center
1.4.7		DOMA function	Analysis of distribution state estimation and power flow results	DOMA makes results of power flow calculations available for analysis.	DOMA function	DOMA function	Results of power flow calculations		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.4.8		DOMA function, ADAHistoricDatabase	Analysis of distribution state estimation and power flow results	DOMA issues a report with results of analysis of state estimation and power flow calculations for storage in historic AdvancedDistributionAutomationSystem database.	DOMA function	ADAHistoric Database	Power flow results, dispatchable kW & kvar, bus voltage limits, customer extreme voltages, segment and xmfr overloads, imbalances, load transfer capacity for selected ties, losses, quality and fault analyses, alarms (if any) about load/voltage violations and from fault analysis, logs		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.4.9		DOMA function, Regional System Operator	Analysis of distribution state estimation and power flow results	Selected results of analysis of power flow calculations are made available for the Regional System Operator and EnergyManagementSystem.	DOMA function	Regional System Operator, EnergyManagementSystem	DOMA function status, dispatchable kW & kvar, bus voltage limits, customer extreme voltages and imbalances, alarms (if any) about load/voltage violations and from fault analysis		Intra-Control Center
1.4.10		DOMA function, distributed intelligence schemes	Analysis of distribution state estimation and power flow results	Analysis of power flow results includes transfer capacity of selected ties, which is transmitted to distributed intelligence schemes.	DOMA function	Distributed intelligence schemes	Transfer capacity of selected ties		Intra-Control Center
1.4.11		DOMA function, ADAVVCController	Analysis of distribution state estimation and power flow results	If analysis of power flow calculations detect a voltage or overload violation, VVC is initiated	DOMA function	ADAVVCController	Initiation of VVC		Intra-Control Center

2.1.2.5 DOMA Study/Look-ahead Mode

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
#	*Triggering event: Identify the name of the event.*[6]	*What other actors are primarily responsible for the Process/Activity. Actors are defined in section1.5.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information.Actors are defined in section1.5.*	*What other actors are primarily responsible for Receiving the information* *Actors are defined in section1.5.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*
1.5.1	DOMA Study/Look Ahead Mode	AM_FM_GIS Database, ConversionValidationFunction	Data conversion and validation	Conversion and validation function receives the latest database download to extract, convert and validate circuit connectivity and transformer loading data (Stage 1) as well as to validate facility parameters via load flow and load transfer analyses (Stage 2).	AM_FM_GIS Database	ConversionValidationFunction	Connectivity, billing and facility parameters		Intra-Control Center
1.5.2		ConversionValidationFunction, ADADatabase	Data conversion and validation	Conversion and validation function updates AdvancedDistributionAutomationSystem database with the latest changes in AM_FM_GISDatabase.	ConversionValidationFunction	ADADatabase	Update of AdvancedDistributionAutomationSystem database		Intra-Control Center

[6] Note – A triggering event is not necessary if the completion of the prior step leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.5.3		ADADispatchingSystem, DOMA function	Preparation of distribution system states as input for DOMA	ADADispatchingSystem, responsible, among other things, for triggering scheduled runs of various AdvancedDistribution AutomationSystem functions, issues a command to initiate the look-ahead mode.	ADADispatchingSystem	DOMA function	Command to initiate look-ahead mode.		Intra-Control Center
1.5.4		Regional System Operator, DOMA function	Preparation of distribution system states as input for DOMA	Regional System Operator gives the command to initiate the study mode.	Regional System Operator	DOMA function	Command to initiate study mode.		User Interface
1.5.5		WorkManagementSystem, DOMA function	Preparation of distribution system states as input for DOMA	DOMA receives information about the outages: present and future, which is reflected in preparation of distribution system state.	WorkManagementSystem	DOMA	Schedules presently active or authorized for future outages		Intra-Control Center
1.5.6		Environmental daily data collector, ADADatabase	AdvancedDistributionAutomationSystem database update	Environmental data for DER operation forecasting is updated in AdvancedDistribution AutomationSystem database.	Environmental daily data collector	ADADatabase	Environmental data for DER load and schedule forecast		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.5.7		ADADatabase, load forecaster	Preparation of distribution system states as input for DOMA	LoadForecaster receives distribution transformer daily loading data and environmental data for DER load to be used in preparation of distribution system state.	ADADatabase	LoadForecaster	Distribution transformers daily loading, environmental data for DER load and schedule forecasts		Intra-Control Center
1.5.8		LoadForecaster, DOMA function	Preparation of distribution system states as input for DOMA	DOMA receives the distribution transformer loading and DER operational forecasts needed for preparation of distribution system states to be studied in the study and look-ahead modes.	LoadForecaster	DOMA function	Distribution transformer loading and DER operational forecasts		Intra-Control Center
1.5.9		ADADatabase, DOMA function	Preparation of distribution system states as input for DOMA	DOMA receives the excerpts from AdvancedDistribution AutomationSystem database needed for preparation of distribution system states.	ADADatabase	DOMA function	Excerpts from AdvancedDistributionAutomation System database		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.5.10		DOMA function	Preparation of distribution system states as input for DOMA	Statuses and analogs associated with the given distribution system state are made available for study and look-ahead modes.	DOMA function	DOMA function	Statuses and analogs		Intra-Control Center
1.5.11		DOMA function	Checking distribution system state	The given distribution system state is checked for inconsistencies.	DOMA function	DOMA function	Input data for a given distribution system state		Intra-Control Center
1.5.12		DOMA function	Performing distribution state estimation and power flow calculations	DOMA function performs distribution power flow calculations making the results available for analyses.	DOMA function	DOMA function	Results of distribution state estimation and power flow calculations		Intra-Control Center
1.5.13		DOMA function, ADAHistoricDatabase	Analysis of distribution power flow calculations results	Analysis of the results of the distribution power flow calculations are made available for archiving.	DOMA function	ADAHistoric Database	Power flow results, dispatchable kW and kvar, bus voltage limits, customer extreme voltages and imbalances, losses, quality and fault analyses, alarms about load/voltage violations, logs.		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
1.5.14		DOMA function, Regional System Operator	Analysis of distribution power flow calculations results	Analysis of the results of the distribution power flow calculations are made available for the Regional System Operator.	DOMA function	Regional System Operator	DOMA status, dispatchable kW and kvar, bus voltage limits, customer extreme voltages and imbalances, alarms about load/voltage violations.		User Interface
1.5.15		DOMA function	Preparation of distribution system states as input for DOMA	Upon completion of analysis of the results of the distribution power flow calculations DOMA function issues a command to start the study of the next distribution system state.	DOMA function	DOMA function	Command to start the study of the next distribution system state.		Intra-Control Center

2.1.3 Steps – Alternative / Exception Sequences

Describe any alternative or exception sequences that may be required that deviate from the normal course of activities. Note instructions are found in previous table.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments

2.1.4 Post-conditions and Significant Results

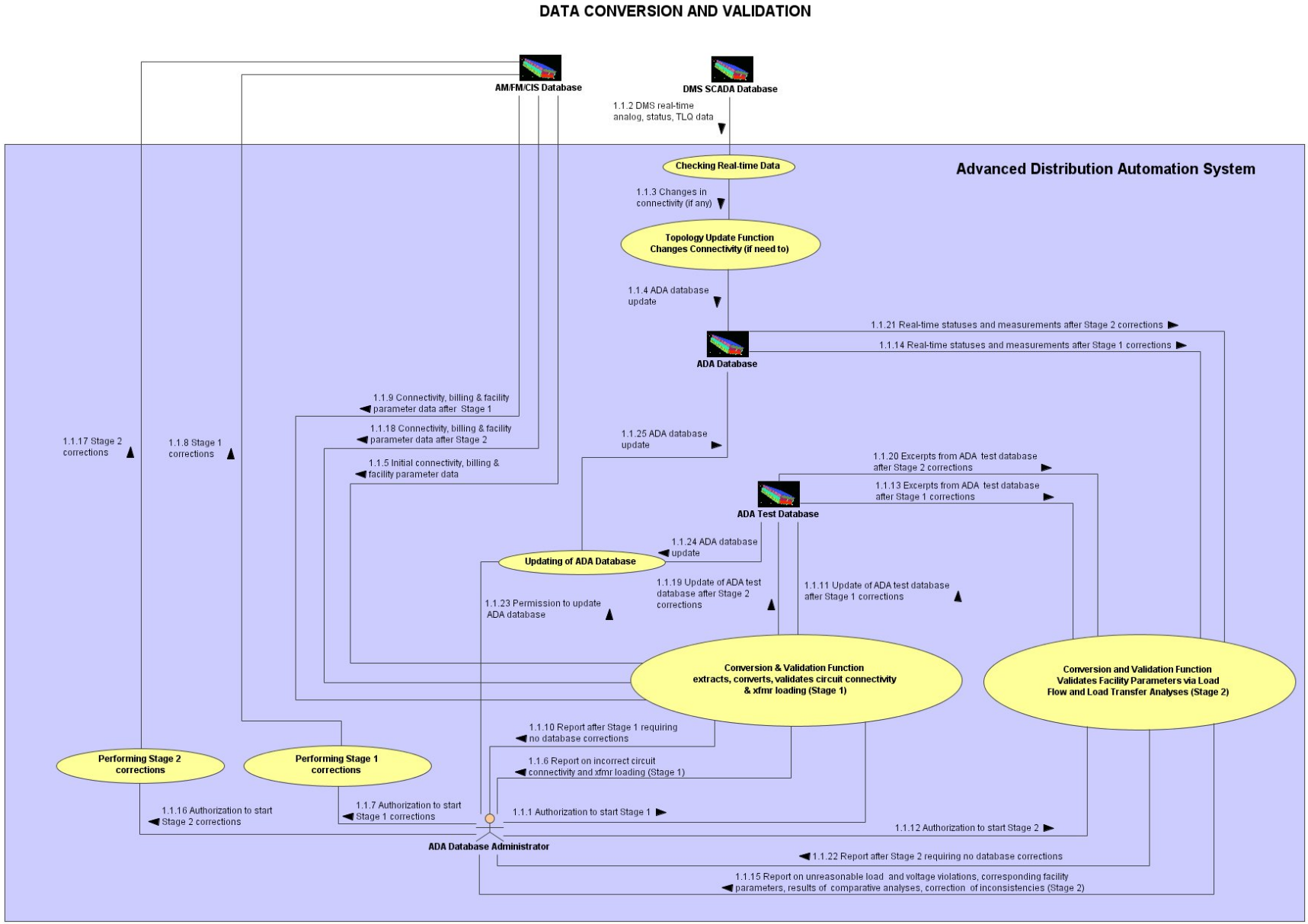
Describe conditions that must exist at the conclusion of the Function. Identify significant items similar to that in the preconditions section.

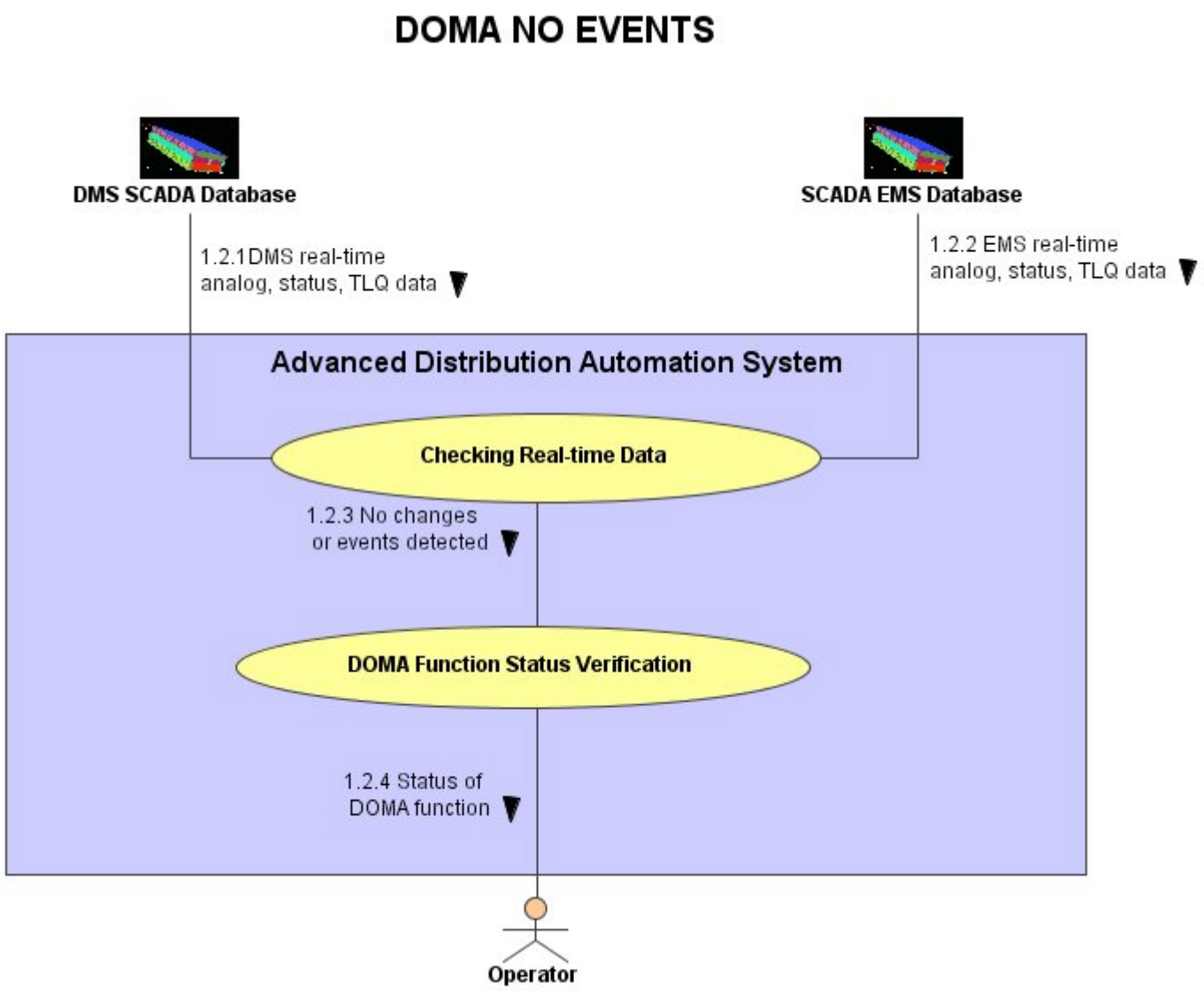
Describe any significant results from the Function

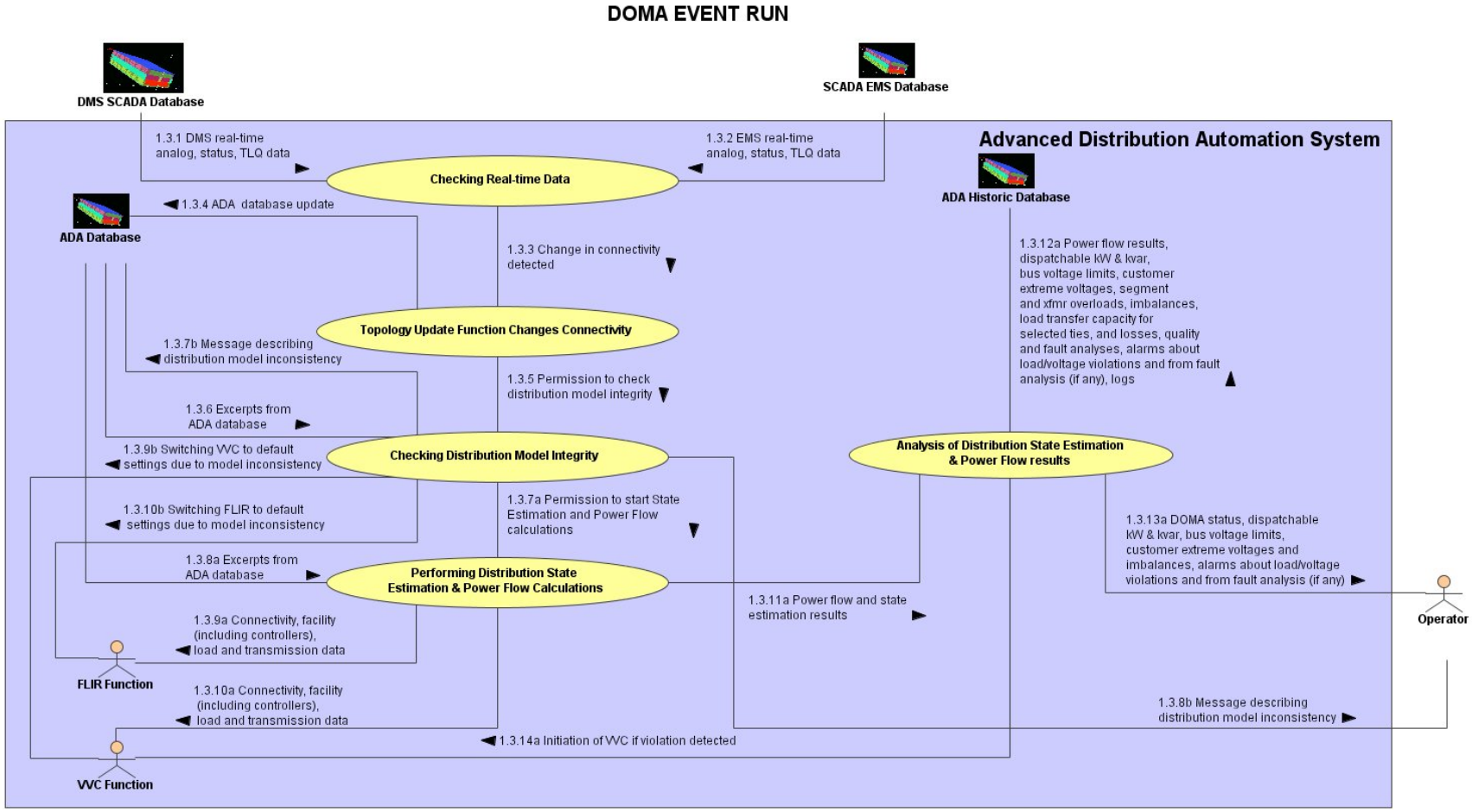
Actor/Activity	***Post-conditions Description and Results***
DOMA in real-time mode	DOMA generates pseudo-measurements for all distribution elements, reveals operational violations, aggregates operational parameters at the demarcation points between distribution and transmission, provides information for pre-arming of distributed intelligence schemes, determines currently available demand response including DER dispatch, prepares model updates for other AdvancedDistributionAutomationSystem-DER functions.
DOMA in look-ahead and study modes	DOMA predicts operational parameters for all distribution elements under expected in near-future and study conditions, operational violations, aggregates operational parameters at the demarcation points between distribution and transmission, determines available in near-future demand response including DER dispatch, prepares model for other AdvancedDistributionAutomationSystem-DER functions in study and look-ahead modes.

2.1.5 Diagrams

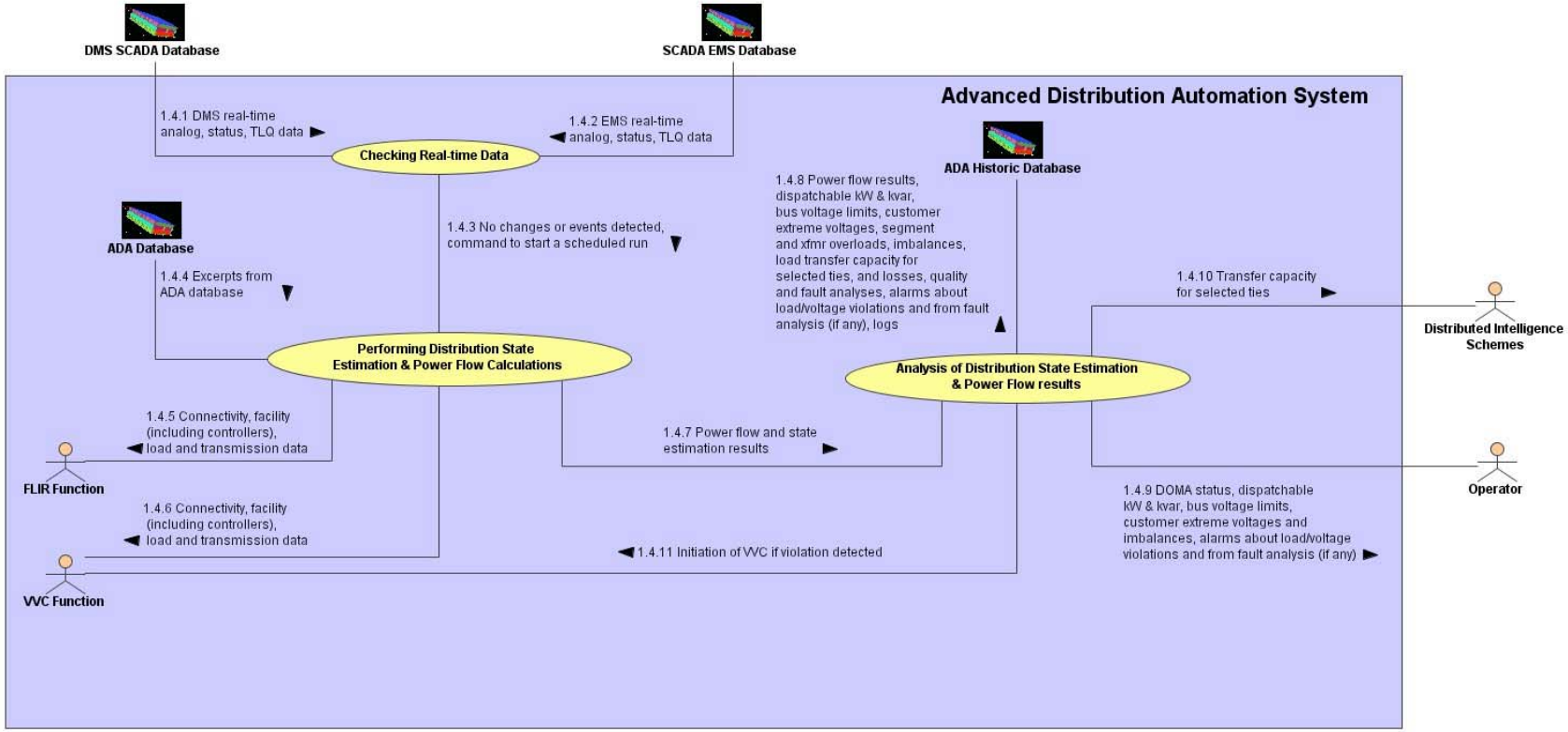
For clarification, draw (by hand, by Power Point, by UML diagram) the interactions, identifying the Steps where possible.

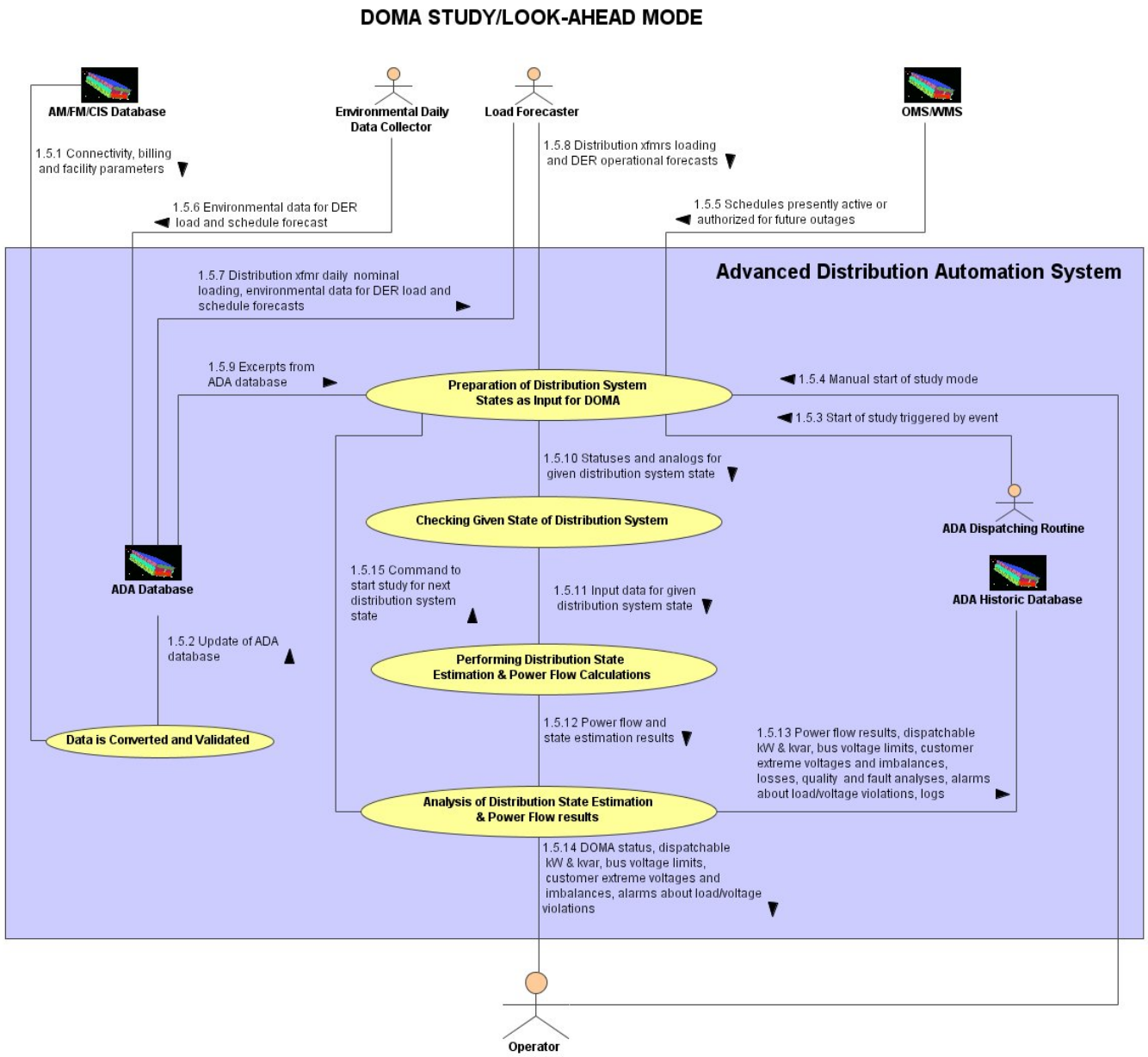

DATA CONVERSION AND VALIDATION
AM/FM/CIS Database
DMS SCADA Database
1.1.2 DMS real-time analog, status, TLQ data
Advanced Distribution Automation System
Checking Real-time Data
1.1.3 Changes in connectivity (if any)
Topology Update Function Changes Connectivity (if need to)
1.1.4 ADA database update
1.1.21 Real-time statuses and measurements after Stage 2 corrections
1.1.14 Real-time statuses and measurements after Stage 1 corrections
ADA Database
1.1.9 Connectivity, billing & facility parameter data after Stage 1
1.1.18 Connectivity, billing & facility parameter data after Stage 2
1.1.5 Initial connectivity, billing & facility parameter data
1.1.17 Stage 2 corrections
1.1.8 Stage 1 corrections
1.1.25 ADA database update
1.1.20 Excerpts from ADA test database after Stage 2 corrections
1.1.13 Excerpts from ADA test database after Stage 1 corrections
ADA Test Database
1.1.24 ADA database update
Updating of ADA Database
1.1.19 Update of ADA test database after Stage 2 corrections
1.1.11 Update of ADA test database after Stage 1 corrections
1.1.23 Permission to update ADA database
Conversion & Validation Function extracts, converts, validates circuit connectivity & xfmr loading (Stage 1)
Conversion and Validation Function Validates Facility Parameters via Load Flow and Load Transfer Analyses (Stage 2)
1.1.10 Report after Stage 1 requiring no database corrections
Performing Stage 2 corrections
Performing Stage 1 corrections
1.1.6 Report on incorrect circuit connectivity and xfmr loading (Stage 1)
1.1.16 Authorization to start Stage 2 corrections
1.1.7 Authorization to start Stage 1 corrections
1.1.1 Authorization to start Stage 1
1.1.12 Authorization to start Stage 2
ADA Database Administrator
1.1.22 Report after Stage 2 requiring no database corrections
1.1.15 Report on unreasonable load and voltage violations, corresponding facility parameters, results of comparative analyses, correction of inconsistencies (Stage 2)


DOMA NO EVENTS
DMS SCADA Database
SCADA EMS Database
1.2.1DMS real-time
analog, status, TLQ data
1.2.2 EMS real-time
analog, status, TLQ data
Advanced Distribution Automation System
Checking Real-time Data
1.2.3 No changes
or events detected
DOMA Function Status Verification
1.2.4 Status of
DOMA function
Operator


DOMA EVENT RUN
DMS SCADA Database
SCADA EMS Database
Advanced Distribution Automation System
1.3.1 DMS real-time analog, status, TLQ data
1.3.2 EMS real-time analog, status, TLQ data
Checking Real-time Data
ADA Historic Database
1.3.4 ADA database update
ADA Database
1.3.3 Change in connectivity detected
1.3.12a Power flow results, dispatchable kW & kvar, bus voltage limits, customer extreme voltages, segment and xfmr overloads, imbalances, load transfer capacity for selected ties, and losses, quality and fault analyses, alarms about load/voltage violations and from fault analysis (if any), logs
Topology Update Function Changes Connectivity
1.3.7b Message describing distribution model inconsistency
1.3.5 Permission to check distribution model integrity
1.3.6 Excerpts from ADA database
1.3.9b Switching VVC to default settings due to model inconsistency
Checking Distribution Model Integrity
Analysis of Distribution State Estimation & Power Flow results
1.3.10b Switching FLIR to default settings due to model inconsistency
1.3.7a Permission to start State Estimation and Power Flow calculations
1.3.13a DOMA status, dispatchable kW & kvar, bus voltage limits, customer extreme voltages and imbalances, alarms about load/voltage violations and from fault analysis (if any)
1.3.8a Excerpts from ADA database
Performing Distribution State Estimation & Power Flow Calculations
Operator
1.3.11a Power flow and state estimation results
1.3.9a Connectivity, facility (including controllers), load and transmission data
FLIR Function
1.3.10a Connectivity, facility (including controllers), load and transmission data
1.3.8b Message describing distribution model inconsistency
1.3.14a Initiation of VVC if violation detected
VVC Function

DOMA SCHEDULED RUN




DOMA STUDY/LOOK-AHEAD MODE
AM/FM/CIS Database
Environmental Daily Data Collector
Load Forecaster
OMS/WMS
1.5.1 Connectivity, billing and facility parameters
1.5.8 Distribution xfmrs loading and DER operational forecasts
1.5.6 Environmental data for DER load and schedule forecast
1.5.5 Schedules presently active or authorized for future outages
Advanced Distribution Automation System
1.5.7 Distribution xfmr daily nominal loading, environmental data for DER load and schedule forecasts
1.5.9 Excerpts from ADA database
Preparation of Distribution System States as Input for DOMA
1.5.4 Manual start of study mode
1.5.3 Start of study triggered by event
1.5.10 Statuses and analogs for given distribution system state
Checking Given State of Distribution System
ADA Dispatching Routine
ADA Database
ADA Historic Database
1.5.15 Command to start study for next distribution system state
1.5.11 Input data for given distribution system state
1.5.2 Update of ADA database
Performing Distribution State Estimation & Power Flow Calculations
Data is Converted and Validated
1.5.12 Power flow and state estimation results
1.5.13 Power flow results, dispatchable kW & kvar, bus voltage limits, customer extreme voltages and imbalances, losses, quality and fault analyses, alarms about load/voltage violations, logs
Analysis of Distribution State Estimation & Power Flow results
1.5.14 DOMA status, dispatchable kW & kvar, bus voltage limits, customer extreme voltages and imbalances, alarms about load/voltage violations
Operator

2.2 Fault Location, Isolation and Service Restoration (FLIR) Function

Name of this sequence.

2.2.1 FLIR Preconditions and Assumptions

Describe conditions that must exist prior to the initiation of the Function, such as prior state of the actors and activities

Identify any assumptions, such as what systems already exist, what contractual relations exist, and what configurations of systems are probably in place

Identify any initial states of information exchanged in the steps in the next section. For example, if a purchase order is exchanged in an activity, its precondition to the activity might be 'filled in but unapproved'.

Actor/System/Information/Contract	*Preconditions or Assumptions*
The same as for DOMA	The same as for DOMA
AdvancedDistributionAutomationSystem: Fault Location Isolation and Service Restoration (FLIR)	Fault Location **Preconditions:** DistributionSCADASystem with fault detectors, Distribution Operation Model and Analysis with fault analysis, fault location relays (schemes) including high impedance relays and Some Distributed Intelligence schemes and Trouble call system exist. Fault Isolation and Service Restoration **Preconditions:** DistributionSCADASystem with ability to control a defined number of switching devices, Fault Location, Distribution Operation Model and Analysis, Voltage and Var Control for adjusting voltage and var after reconfiguration. Supervisory and closed-loop control of switches are available. Some Distributed Intelligence schemes exist.
OutageManagementSystem	Outage Management System is interfaced with SCADA and AdvancedDistributionAutomationSystem and supports a dynamic topology model.
EnergyManagementSystem (WAMACS)	EnergyManagementSystem is interfaced with WAMACS and AdvancedDistributionAutomationSystem and provides phasor data for all distribution (reference) buses.
Regional System Operator	Regional System Operator has AdvancedDistributionAutomationSystem GUI and uses it for supervisory control of switches, for entering pseudo-SCADA statuses, selecting isolation and restoration alternatives, etc. The operator also has the ability to communicate with the field crews via mobile communications and computing.
FieldPersonnel	FieldPersonnels are able to communicate with the operator via mobile communications and computing
Distributed Intelligence Schemes	DIS team members are able to operate in a coordinated manner based on peer-to-peer communications or based on operational parameters, and DIS team masters are able to communicate via fast peer-to-peer communications
AdvancedDistributionAutomationSystem: Prearming of Remedial Action Schemes application	The pre-arming application downloads operating conditions to DIS masters based on DOMA results
Historic DB	Historic database is able to store large amount of data about outages, which will be used by the outage

Actor/System/Information/Contract	*Preconditions or Assumptions*
	statistic application and other users.
Environmental daily data collector	Environmental daily data collector collects environmental data used for DER schedule forecast.
ADATopologyUpdateSystem	ADATopologyUpdateSystem changes connectivity in AdvancedDistributionAutomationSystem database based on changes detected in real-time DMS and EnergyManagementSystem SCADA.
Fault location function	Fault-locating function provides distances to fault location, which are used by operator or FLIR function, along with other relevant data, to guide activities of field crews.

2.2.2 FLIR Steps – Normal Sequence

Describe the normal sequence of events, focusing on steps that identify new types of information or new information exchanges or new interface issues to address. Should the sequence require detailed steps that are also used by other functions, consider creating a new "sub" function, then referring to that "subroutine" in this function. Remember that the focus should be less on the algorithms of the applications and more on the interactions and information flows between "entities", e.g. people, systems, applications, data bases, etc. There should be a direct link between the narrative and these steps.

The numbering of the sequence steps conveys the order and concurrency and iteration of the steps occur. Using a Dewey Decimal scheme, each level of nested procedure call is separated by a dot '.'. Within a level, the sequence number comprises an optional letter and an integer number. The letter specifies a concurrent sequence within the next higher level; all letter sequences are concurrent with other letter sequences. The number specifies the sequencing of messages in a given letter sequence. The absence of a letter is treated as a default 'main sequence' in parallel with the lettered sequences.

Sequence 1:

```
1.1 - Do step 1
1.2A.1 - In parallel to activity 2 B do step 1
1.2A.2 - In parallel to activity 2 B do step 2
1.2B.1 - In parallel to activity 2 A do step 1
1.2B.2 - In parallel to activity 2 A do step 2
1.3 - Do step 3
1.3.1 - nested step 3.1
1.3.2 - nested step 3.2
```

Sequence 2:

2.1 - Do step 1
2.2 – Do step 2

2.2.2.1 FLIR First Fault with Only Manual Switches

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
#	*Triggering event? Identify the name of the event.*[7]	*What other actors are primarily responsible for the Process/Activity? Actors are defined in section1.5.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information? Actors are defined in section1.5.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section1.5.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*
2.1.1	FLIR first fault with only manual switches	DMS SCADA database, DOMA function	Checking real-time data	DOMA function receives the scan of DMS SCADA data to be checked for changes in topology. It also provides the latest relevant analog data.	DMS SCADA database	DOMA function	DMS real-time analog, status & TLQ data		Intra-Control Center
2.1.2		EnergyManagementSystem SCADA database, DOMA function	Checking real-time data	DOMA function receives the scan of EnergyManagementSystem SCADA data to be checked for relevant changes or events.	EnergyManagementSystem SCADA database	DOMA function	EnergyManagementSystem real-time analog, status, TLQ data		Intra-Control Center

[7] Note – A triggering event is not necessary if the completion of the prior step – leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.1.3		Environmental daily data collector, DOMA function	Checking real-time data	DOMA function receives the scan of environmental data to be checked for changes affecting DER performance forecast.	Environmental daily data collector	DOMA function	Real-time environmental data for DER schedule forecast		Intra-Control Center
2.1.4		OutageManagementSystem, DOMA function	Checking real-time data	DOMA function receives the scan of latest schedules of presently active or authorized for future outages to be checked for changes during the time of repair.	OutageManagementSystem	DOMA function	Schedules of presently active or authorized for future outages		Intra-Control Center
2.1.5		DOMA function, ADATopologyUpdateSystem	ADATopologyUpdateSystem changes connectivity	After DOMA detects fault in distribution, relevant information is provided to topology function.	DOMA function	ADATopologyUpdateSystem	Circuit breaker lockouts, inputs from OutageManagementSystem		Intra-Control Center
2.1.6		ADATopologyUpdateSystem, ADADatabase	ADATopologyUpdateSystem changes connectivity	After fault is detected, AdvancedDistributionAutomationSystem database is updated.	ADATopologyUpdateSystem	ADADatabase	Update of AdvancedDistributionAutomationSystem database		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.1.7		ADATopologyUpdateSystem, FLIR function	Fault location sub-function identifies fault-related protective devices and de-energized sections	Topology function initiates fault location sub-function of the FLIR function.	ADATopologyUpdateSystem	FLIR function	Fault location sub-function initiation		Intra-Control Center
2.1.8		ADADatabase, FLIR function	Fault location sub-function identifies fault-related protective devices and de-energized sections	Fault location sub-function receives the needed data from AdvancedDistributionAutomationSystem database after it was updated with fault information.	ADADatabase	FLIR function	Excerpts from AdvancedDistributionAutomationSystem database updated after fault detection		Intra-Control Center
2.1.9		FLIR function, Regional System Operator	Fault location sub-function identifies fault-related protective devices and de-energized sections	Fault location sub-function provides the Regional System Operator with information needed for him to make operational decisions, i.e., dispatching the field crew, etc.	FLIR function	Regional System Operator	Circuit breaker lockouts, inputs from OutageManagementSystem, fault-related de-energized sections		User Interface
2.1.10		Fault location function, Regional System Operator	Fault-location relay informs Regional System Operator	Regional System Operator receives distances to fault location provided by the fault location relay.	Fault location function	Regional System Operator	Distances to fault location		User Interface

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.1.12		Regional System Operator, field crew	Regional System Operator informs field crew	Regional System Operator authorizes to patrol the faulted line to locate fault and perform binary search if needed.	Regional System Operator	FieldPersonnel	Authorization to patrol faulted line		User Interface
2.1.13		FieldPersonnel, Regional System Operator	FieldPersonnel informs Regional System Operator	After locating the fault, the crew informs the Regional System Operator about the status of switches involved in initial fault isolation.	FieldPersonnel	Regional System Operator	Status of switches involved in initial fault isolation		User Interface
2.1.14, 2.1.15		Regional System Operator	Entering status of switches and faulted section into AdvancedDistributionAutomationSystem database	The Regional System Operator enters status of switches (pseudo-statuses) involved in initial fault isolation and the faulted section into AdvancedDistributionAutomationSystem database.	Regional System Operator	ADADatabase	AdvancedDistributionAutomationSystem database update after initial fault isolation		User Interface

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.1.16		Regional System Operator, FLIR function	Fault isolation and service restoration sub-function generates list of recommended switching orders	By entering the faulted section into the AdvancedDistributionAutomationSystem database, the Regional System Operator initiates fault isolation and service restoration sub-function.	Regional System Operator	FLIR	Initiation of fault isolation and service restoration sub-function		User Interface
2.1.17		ADADatabase, FLIR function	Fault isolation and service restoration sub-function generates list of recommended switching orders	Fault isolation and service restoration sub-function receives AdvancedDistributionAutomationSystem database excerpts updated after initial fault isolation.	ADADatabase	FLIR function	AdvancedDistributionAutomationSystem database excerpts updated after initial fault isolation		Intra-Control Center
2.1.18		FLIR function, ADAHistoricDatabase	Fault isolation and service restoration sub-function generates list of recommended switching orders	FLIR issues a report for archiving in AdvancedDistributionAutomationSystem historic database	FLIR function	ADAHistoricDatabase	Report including interrupted, un-served and restored load, and number of customers		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.1.19		FLIR function, Regional System Operator	Fault isolation and service restoration sub-function generates list of recommended switching orders	A generated list of recommended switching orders is presented to the Regional System Operator.	FLIR function	Regional System Operator	List of recommended switching orders		User Interface
2.1.20		Regional System Operator, field crew	Regional System Operator informs field crew	Regional System Operator selects a switching order and authorizes its implementation.	Regional System Operator	FieldPersonnel	Switching order authorized for implementation		User Interface
2.1.21		FieldPersonnel, Regional System Operator	FieldPersonnel informs Regional System Operator	Upon final isolation and service restoration to healthy sections, the field crew informs the Regional System Operator about final status of relevant switches (cuts).	FieldPersonnel	Regional System Operator	Status of switches involved in final fault isolation and service restoration to healthy sections.		User Interface

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.1.22, 2.1.23		Regional System Operator	Entering status of switches involved in final fault isolation and service restoration to healthy sections into AdvancedDistributionAutomationSystem database	The Regional System Operator enters status of switches/cuts (pseudo-statuses) involved in final fault isolation and service restoration to healthy sections into AdvancedDistributionAutomationSystem database	Regional System Operator	ADADatabase	AdvancedDistributionAutomationSystem database update after final fault isolation and service restoration		User Interface
2.1.24		FLIR	FLIR updates the switching order in accord with the final fault isolation	Regional System Operator receives the final switching order from FLIR and dispatched the crew to implement it	FLIR, Regional System Operator	Regional System Operator, FieldPersonnel	Switching order, instructions to the crew		User Interface

2.2.2.2 FLIR Second Fault (Related to First Fault which is Not Resolved Yet) with Only Manual Switches

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
#	*Triggering event? Identify the name of the event.*[8]	*What other actors are primarily responsible for the Process/Activity? Actors are defined in section1.5.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information? Actors are defined in section1.5.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section1.5.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*
2.2.1	FLIR second fault (related to first fault which is not resolved yet) with only manual switches	DMS SCADA database, DOMA function	Checking real-time data	DOMA function receives the scan of DMS SCADA data to be checked for changes in topology. It also provides the latest relevant analog data.	DMS SCADA database	DOMA function	DMS real-time analog, status & TLQ data at time of first fault		Intra-Control Center
2.2.2		EnergyManagementSystem SCADA database, DOMA function	Checking real-time data	DOMA function receives the scan of EnergyManagementSystem SCADA data to be checked for relevant changes or events.	EnergyManagementSystem SCADA database	DOMA function	EnergyManagementSystem real-time analog, status, TLQ data at time of first fault		Intra-Control Center

[8] Note – A triggering event is not necessary if the completion of the prior step – leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.2.3		Environmental daily data collector, DOMA function	Checking real-time data	DOMA function receives the scan of environmental data to be checked for changes affecting DER performance forecast.	Environmental daily data collector	DOMA function	Real-time environmental data for DER schedule forecast at time of first fault		Intra-Control Center
2.2.4		OutageManagementSystem, DOMA function	Checking real-time data	DOMA function receives the scan of latest schedules of presently active or authorized for future outages to be checked for changes.	OutageManagementSystem	DOMA function	Schedules of presently active or authorized for future outages at time of first fault		Intra-Control Center
2.2.5		DOMA function, ADATopologyUpdateSystem	ADATopologyUpdateSystem changes connectivity	After DOMA detects first fault in distribution, relevant information is provided to topology function.	DOMA function	ADATopologyUpdateSystem	First fault: circuit breaker lockouts, inputs from OutageManagementSystem		Intra-Control Center
2.2.6		ADATopologyUpdateSystem, ADADatabase	ADATopologyUpdateSystem changes connectivity	After first fault is detected, AdvancedDistributionAutomationSystem database is updated.	ADATopologyUpdateSystem	ADADatabase	Update of AdvancedDistributionAutomationSystem database after first fault detection		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.2.7		ADATopologyUpdateSystem, FLIR function	Fault location sub-function identifies fault-related protective devices and de-energized sections	After the first fault is detected, topology function initiates fault location sub-function of the FLIR function.	ADATopologyUpdateSystem	FLIR function	Fault location sub-function initiation after first fault		Intra-Control Center
2.2.8		ADADatabase, FLIR function	Fault location sub-function identifies fault-related protective devices and de-energized sections	Fault location sub-function receives the needed data from AdvancedDistributionAutomationSystem database after it was updated with the first fault information.	ADADatabase	FLIR function	Excerpts from AdvancedDistributionAutomationSystem database updated after first fault detection		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.2.9		FLIR function, Regional System Operator	Fault location sub-function identifies fault-related protective devices and de-energized sections	Fault location sub-function provides the Regional System Operator with information on the first fault needed for him to make operational decisions, i.e., dispatching the field crew, etc.	FLIR function	Regional System Operator	First fault: circuit breaker lockouts, inputs from OutageManagementSystem, fault-related de-energized sections		User Interface
2.2.10		Regional System Operator, field crew	Regional System Operator informs field crew	Regional System Operator authorizes to patrol the faulted line to locate first fault and perform binary search if needed.	Regional System Operator	FieldPersonnel	Authorization to patrol faulted line to locate first fault		User Interface
2.2.11		FieldPersonnel, Regional System Operator	FieldPersonnel informs Regional System Operator	After locating the first fault, the crew informs the Regional System Operator about the status of switches involved in initial fault isolation.	FieldPersonnel	Regional System Operator	Status of switches involved in initial first fault isolation		User Interface

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.2.12, 2.2.13		Regional System Operator	Entering status of switches and faulted section into Advanced DistributionAutomationSystem database	The Regional System Operator enters status of switches (pseudo-statuses) involved in initial first fault isolation and the faulted section into AdvancedDistributionAutomationSystem database.	Regional System Operator	ADADatabase	AdvancedDistributionAutomationSystem database update after initial isolation of first fault		User Interface
2.2.14		Regional System Operator, FLIR function	Fault isolation and service restoration sub-function generates list of recommended switching orders	By entering the faulted section, associated with first fault, into the AdvancedDistributionAutomationSystem database, the Regional System Operator initiates fault isolation and service restoration sub-function.	Regional System Operator	FLIR	Initiation of fault isolation and service restoration sub-function		User Interface

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.2.15		ADADatabase, FLIR function	Fault isolation and service restoration sub-function generates list of recommended switching orders	Fault isolation and service restoration sub-function receives AdvancedDistributionAutomationSystem database excerpts updated after initial first fault isolation.	ADADatabase	FLIR function	AdvancedDistributionAutomationSystem database excerpts updated after initial isolation of first fault		Intra-Control Center
2.2.16		FLIR function, ADAHistoricDatabase	Fault isolation and service restoration sub-function generates list of recommended switching orders	FLIR issues a report after the first fault for archiving in AdvancedDistributionAutomationSystem historic database	FLIR function	ADAHistoric Database	Report including interrupted, un-served and restored load, and number of customers after first fault		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.2.17		FLIR function, Regional System Operator	Fault isolation and service restoration sub-function generates list of recommended switching orders	A generated list of recommended switching orders related to first fault is presented to the Regional System Operator.	FLIR function	Regional System Operator	List of recommended switching orders related to first fault		User Interface
2.2.18	FLIR second fault (related to first fault which is not resolved yet) with only manual switches	DMS SCADA database, DOMA function	Checking real-time data	DOMA function receives the scan of DMS SCADA data to be checked for changes in topology. It also provides the latest relevant analog data.	DMS SCADA database	DOMA function	DMS real-time analog, status & TLQ data at time of second fault		Intra-Control Center
2.2.19		EnergyManagementSystem SCADA database, DOMA function	Checking real-time data	DOMA function receives the scan of EnergyManagementSystem SCADA data to be checked for relevant changes or events.	EnergyManagementSystem SCADA database	DOMA function	EnergyManagementSystem real-time analog, status, TLQ data at time of second fault		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.2.20		Environmental daily data collector, DOMA function	Checking real-time data	DOMA function receives the scan of environmental data to be checked for changes affecting DER performance forecast.	Environmental daily data collector	DOMA function	Real-time environmental data for DER schedule forecast at time of second fault		Intra-Control Center
2.2.21		OutageManagementSystem, DOMA function	Checking real-time data	DOMA function receives the scan of latest schedules of presently active or authorized for future outages to be checked for changes.	OutageManagementSystem	DOMA function	Schedules of presently active or authorized for future outages at time of second fault		Intra-Control Center
2.2.22		DOMA function, ADATopologyUpdateSystem	ADATopologyUpdateSystem changes connectivity	After DOMA detects second fault in distribution, relevant information is provided to topology function.	DOMA function	ADATopologyUpdateSystem	Second fault: circuit breaker lockouts, inputs from OutageManagementSystem		Intra-Control Center
2.2.23		ADATopologyUpdateSystem, ADADatabase	ADATopologyUpdateSystem changes connectivity	After second fault is detected, AdvancedDistributionAutomationSystem database is updated.	ADATopologyUpdateSystem	ADADatabase	Update of AdvancedDistributionAutomationSystem database after second fault detection		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.2.24		ADATopologyUpdateSystem, FLIR function	Fault location sub-function identifies fault-related protective devices and de-energized sections	After the second fault is detected, topology function initiates fault location sub-function of the FLIR function.	ADATopologyUpdateSystem	FLIR function	Fault location sub-function initiation after second fault		Intra-Control Center
2.2.25		ADADatabase, FLIR function	Fault location sub-function identifies fault-related protective devices and de-energized sections	Fault location sub-function receives the needed data from AdvancedDistributionAutomationSystem database after it was updated with the second fault information.	ADADatabase	FLIR function	Excerpts from AdvancedDistributionAutomationSystem database updated after second fault detection		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.2.26		FLIR function	Fault isolation and service restoration sub-function determines whether second fault impacts switching for first fault	Fault isolation and service restoration sub-function determines whether second fault impacts switching for first fault.	FLIR function	FLIR function	Second fault: circuit breaker lockouts, inputs from OutageManagementSystem, fault-related de-energized sections		Intra-Control Center
2.2.27		FLIR function	Fault isolation and service restoration sub-function determines whether second fault impacts switching for first fault	Fault isolation and service restoration sub-function cancels the previous switching order if it needs to.	FLIR function	Regional System Operator	Cancellation of first-fault-related switching order		User Interface

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.2.28		Regional System Operator, field crew	Regional System Operator informs field crew	Regional System Operator authorizes to patrol the faulted line to locate second fault and perform binary search if needed.	Regional System Operator	FieldPersonnel	Authorization to patrol faulted line to locate second fault		User Interface
2.2.29		FieldPersonnel, Regional System Operator	FieldPersonnel informs Regional System Operator	After locating the second fault, the crew informs the Regional System Operator about the status of switches involved in initial second fault isolation.	FieldPersonnel	Regional System Operator	Status of switches involved in initial second fault isolation		User Interface
2.2.30, 2.2.31		Regional System Operator	Entering status of switches and faulted section into Advanced DistributionAutomationSystem database	The Regional System Operator enters status of switches (pseudo-statuses) involved in initial second fault isolation and the faulted section into AdvancedDistributionAutomationSystem database.	Regional System Operator	ADADatabase	AdvancedDistributionAutomationSystem database update after initial isolation of second fault		User Interface

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.2.32		Regional System Operator, FLIR function	Fault isolation and service restoration sub-function generates list of recommended switching orders	By entering the faulted section, associated with second fault, into the AdvancedDistributionAutomationSystem database, the Regional System Operator initiates fault isolation and service restoration sub-function for both faults.	Regional System Operator	FLIR	Initiation of fault isolation and service restoration sub-function		User Interface
2.2.33		ADADatabase, FLIR function	Fault isolation and service restoration sub-function generates list of recommended switching orders	Fault isolation and service restoration sub-function receives AdvancedDistributionAutomationSystem database excerpts updated after initial second fault isolation.	ADADatabase	FLIR function	AdvancedDistributionAutomationSystem database excerpts updated after initial isolation of second fault		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.2.34		FLIR function, ADAHistoricDatabase	Fault isolation and service restoration sub-function generates list of recommended switching orders	FLIR issues a report after the second fault for archiving in AdvancedDistributionAutomationSystem historic database	FLIR function	ADAHistoricDatabase	Report including interrupted, un-served and restored load, and number of customers after second fault		Intra-Control Center
2.2.35		FLIR function, Regional System Operator	Fault isolation and service restoration sub-function generates list of recommended switching orders	A generated list of recommended switching orders related to both faults is presented to the Regional System Operator.	FLIR function	Regional System Operator	List of recommended switching orders related to second fault		User Interface
2.2.36		Regional System Operator, field crew	Regional System Operator informs field crew	Regional System Operator selects a switching order and authorizes its implementation.	Regional System Operator	FieldPersonnel	Switching order authorized for implementation after second fault		User Interface

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.2.37		FieldPersonnel, Regional System Operator	FieldPersonnel informs Regional System Operator	Upon final isolation and service restoration to healthy sections, the field crew informs the Regional System Operator about final status of relevant switches for the second fault.	FieldPersonnel	Regional System Operator	Status of switches involved in final fault isolation and service restoration to healthy sections after second fault.		User Interface
2.2.38, 2.2.39		Regional System Operator	Entering status of switches involved in final fault isolation and service restoration to healthy sections into AdvancedDistributionAutomationSystem database	The Regional System Operator enters status of switches (pseudo-statuses) involved in final fault isolation and service restoration to healthy sections into AdvancedDistributionAutomationSystem database	Regional System Operator	ADADatabase	AdvancedDistributionAutomationSystem database update after final fault isolation and service restoration		User Interface

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.2.40	FLIR	FLIR updates the switching order in accord with the final isolation of both faults	Regional System Operator receives the final switching order from FLIR and dispatched the crew to implement it	FLIR, Regional System Operator	Regional System Operator	FieldPersonnel	Switching order, instructions to the crew		User Interface

2.2.2.3 FLIR Fault with Remotely-Controlled and Manual Switches

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
#	*Triggering event? Identify the name of the event.*[9]	*What other actors are primarily responsible for the Process/Activity? Actors are defined in section1.5.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information? Actors are defined in section1.5.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section1.5.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*

[9] Note – A triggering event is not necessary if the completion of the prior step – leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.3.1	FLIR fault with remotely-controlled and manual switches	DMS SCADA database, DOMA function	Checking real-time data	DOMA function receives the scan of DMS SCADA data to be checked for changes in topology. It also provides the latest relevant analog data.	DMS SCADA database	DOMA function	DMS real-time analog, status & TLQ data		Intra-Control Center
2.3.2		EnergyManagementSystem SCADA database, DOMA function	Checking real-time data	DOMA function receives the scan of EnergyManagementSystem SCADA data to be checked for relevant changes or events.	EnergyManagementSystem SCADA database	DOMA function	EnergyManagementSystem real-time analog, status, TLQ data		Intra-Control Center
2.3.3		Environmental daily data collector, DOMA function	Checking real-time data	DOMA function receives the scan of environmental data to be checked for changes affecting DER performance forecast.	Environmental daily data collector	DOMA function	Real-time environmental data for DER schedule forecast		Intra-Control Center
2.3.4		OutageManagementSystem, DOMA function	Checking real-time data	DOMA function receives the scan of latest schedules of presently active or authorized for future outages to be checked for changes.	OutageManagementSystem	DOMA function	Schedules of presently active or authorized for future outages		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.3.5		Fault location function, DOMA function	Checking real-time data	DOMA function receives the distance to fault location, which is provided by Fault location function in the presence of the fault.	Fault location function	DOMA function	Distance to fault location		Intra-Control Center
2.3.6		DOMA function, ADATopologyUpdateSystem	ADATopologyUpdateSystem changes connectivity	After DOMA detects fault in distribution, relevant information is provided to topology function.	DOMA function	ADATopologyUpdateSystem	Circuit breaker lockouts, inputs from OutageManagementSystem		Intra-Control Center
2.3.7		ADATopologyUpdateSystem, ADADatabase	ADATopologyUpdateSystem changes connectivity	After fault is detected, AdvancedDistributionAutomationSystem database is updated.	ADATopologyUpdateSystem	ADADatabase	Update of AdvancedDistributionAutomationSystem database		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.3.8		ADATopologyUpdateSystem, FLIR function	Fault location sub-function identifies fault-related protective devices and de-energized sections	Topology function initiates fault location sub-function of the FLIR function.	ADATopologyUpdateSystem	FLIR function	Fault location subfunction initiation		Intra-Control Center
2.3.9		ADADatabase, FLIR function	Fault location subfunction identifies fault-related protective devices and de-energized sections	Fault location subfunction receives the needed data from AdvancedDistributionAutomationSystem database after it was updated with fault information.	ADADatabase	FLIR function	Excerpts from AdvancedDistributionAutomation System database updated after fault detection		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.3.10		FLIR function	Fault isolation and service restoration sub-function generates list of recommended switching orders	Fault location subfunction initiates fault isolation and service restoration sub-function of the FLIR function.	Fault location function	Fault isolation and service restoration subfunction	Fault isolation and service restoration sub-function initiation, probable fault location with alternatives		Intra-Control Center
2.3.11		ADADatabase, FLIR function	Fault isolation and service restoration sub-function generates list of recommended switching orders	Fault isolation and service restoration sub-function receives AdvancedDistributionAutomationSystem database excerpts updated with fault information.	ADADatabase	FLIR function	AdvancedDistributionAutomationSystem database excerpts		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.3.12		FLIR function, ADAHistoricDatabase	Fault isolation and service restoration sub-function generates list of recommended switching orders	FLIR issues a report for archiving in AdvancedDistributionAutomationSystem historic database.	FLIR function	ADAHistoric Database	Report including interrupted, un-served and restored load, and number of customers before additional fault isolation		Intra-Control Center
2.3.13a		FLIR function, Regional System Operator	Fault isolation and service restoration sub-function generates list of recommended switching orders	A list of recommended switching orders using remotely controlled switches is presented to the Regional System Operator.	FLIR function	Regional System Operator	List of switching orders recommended after fault detection		User Interface

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.3.13b		FLIR function	Fault isolation and service restoration sub-function generates list of recommended switching orders	In advisory mode, Regional System Operator considers the list of switching order alternatives and selects the best SO based on predefined criteria	FLIR function	Regional System Operator	List of switching orders recommended after fault detection		User Interface
2.3.14a		Regional System Operator, DMS SCADA database	SO execution	In the advisory mode, the Regional System Operator, after reviewing SO, issues supervisory commands to execute it.	Regional System Operator	DMS SCADA database	Supervisory command to execute SO issued after fault detection		User Interface
2.3.14b		FLIR, DMS SCADA database	SO execution	In the closed-loop mode, FLIR issues command to execute the best SO.	FLIR	DMS SCADA database	Supervisory command to execute SO issued after fault detection		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.3.15		Regional System Operator, field crew	Regional System Operator informs field crew	Regional System Operator authorizes to patrol the faulted section to accurately locate the fault and perform binary search if needed.	Regional System Operator	FieldPersonnel	Authorization to patrol faulted line		User Interface
2.3.16		FieldPersonnel, Regional System Operator	FieldPersonnel informs Regional System Operator	After accurately locating the fault, the crew informs the Regional System Operator about the status of switches involved in additional switching to isolate the smallest possible faulted section.	FieldPersonnel	Regional System Operator	Status of switches involved in isolating the smallest possible faulted section		User Interface
2.3.17, 2.3.18		Regional System Operator, ADADatabase	Entering status of switches and faulted section into AdvancedDistributionAutomationSystem database	The Regional System Operator enters status of switches (pseudo-statuses) involved in finall fault isolation and the faulted section into AdvancedDistributionAutomationSystem database.	Regional System Operator	ADADatabase	AdvancedDistributionAutomationSystem database update additional fault isolation		User Interface

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.3.19		Regional System Operator, FLIR	Entering status of switches and faulted section into Advanced DistributionAutomationSystem database	Entering the faulted section into AdvancedDistributionAutomationSystem database initiates FLIR for generating final SO	ADADatabase	FLIR	Fault isolation and service restoration sub-function initiation after additional fault isolation		Intra-Control Center
2.3.20		ADADatabase, FLIR function	Fault isolation and service restoration sub-function generates list of recommended switching orders	Fault isolation and service restoration sub-function receives AdvancedDistributionAutomationSystem database excerpts updated after additional fault isolation.	ADADatabase	FLIR function	AdvancedDistributionAutomationSystem database excerpts		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.3.21		FLIR function, ADAHistoricDatabase	Fault isolation and service restoration sub-function generates list of recommended switching orders	FLIR issues a report for archiving in AdvancedDistributionAutomationSystem historic database.	FLIR function	ADAHistoric Database	Report including interrupted, un-served and restored load, and number of customers after additional fault isolation		Intra-Control Center
2.3.22a		FLIR function, Regional System Operator	Fault isolation and service restoration sub-function generates list of recommended switching orders	A list of recommended final switching orders is presented to the Regional System Operator.	FLIR function	Regional System Operator	List of switching orders recommended after additional fault isolation		User Interface
2.3.23a		Regional System Operator, DMS SCADA database	SO execution	In the advisory mode, the Regional System Operator, after reviewing SO, issues supervisory commands to execute it.	Regional System Operator	DMS SCADA database	Supervisory command to execute SO issued after additional fault isolation		User Interface

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.3.23b		FLIR, DMS SCADA database	SO execution	In the closed-loop mode, FLIR issues commands to execute SO.	FLIR	DMS SCADA database	Supervisory command to execute SO issued after additional fault isolation		Intra-Control Center

2.2.2.4 FLIR Fault with Remotely-Controlled and Manual Switches and Distributed Intelligence System (DIS)

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
#	*Triggering event? Identify the name of the event.*[10]	*What other actors are primarily responsible for the Process/Activity? Actors are defined in section1.5.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information? Actors are defined in section1.5.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section1.5.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*

[10] Note – A triggering event is not necessary if the completion of the prior step – leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.4.1a	Fault with remotely-controlled and manual switches and with DIS	IEDs of DIS members, Distributed Intelligence Schemes	DIS identifies relevant protective device, de-energized sections and probable fault location and finds service restoration solution	Distributed Intelligence System (DIS) receives the real-time local status and analog data.	IEDs of DIS members	Distributed Intelligence Schemes	Real-time local status and analog data		Intra-Control Center
2.4.2a		Distributed Intelligence Schemes, IEDs of DIS members	DIS identifies relevant protective device, de-energized sections and probable fault location and finds service restoration solution	DIS communicates to DIS members the switching instructions for fault isolation and service restoration.	Distributed Intelligence Schemes	IEDS of DIS members	Command to isolate fault and restore service to healthy sections.		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.4.3a		Distributed Intelligence Schemes, DMS SCADA database	DIS identifies relevant protective device, de-energized sections and probable fault location and finds service restoration solution	Changes in connectivity implemented by DIS are downloaded into DMS SCADA database.	Distributed Intelligence Schemes	DMS SCADA database	Changes in connectivity implemented by DIS		Intra-Control Center
2.4.4a		DMS SCADA database, DOMA function	Checking real-time data	DOMA function receives the scan of DMS SCADA data to be checked for changes in topology. It also receives the latest relevant analog data.	DMS SCADA database	DOMA function	DMS real-time analog, status & TLQ data, phasor data from WAMACS		Intra-Control Center
2.4.5a		DOMA function, topology update function	Checking real-time data	ADATopologyUpdateSystem receives the changes in connectivity implemented by DIS	DOMA function	ADATopologyUpdateSystem	Changes in connectivity implemented by DIS		Intra-Control Center
2.4.6a		ADATopology UpdateSystem, ADADatabase	ADATopologyUpdate System changes connectivity	AdvancedDistributionAutomationSystem database is updated with changes in connectivity implemented by DIS	ADATopologyUpdateSystem	ADADatabase	Changes in connectivity implemented by DIS		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.4.1b		IEDs of DIS members, Distributed Intelligence Schemes	DIS identifies relevant protective device, de-energized sections and probable fault location and can not find service restoration solution	Distributed Intelligence System (DIS) receives real-time local status and analog data.	IEDs of DIS members	Distributed Intelligence Schemes	Real-time status and analog data		Intra-Control Center
2.4.2b		Distributed Intelligence Schemes, DMS SCADA database	DIS identifies relevant protective device, de-energized sections and probable fault location and can not find service restoration solution	Indication of DIS inability to find a solution is downloaded into DMS SCADA database.	Distributed Intelligence Schemes	DMS SCADA database	Indication of DIS inability to find a solution		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.4.3b		DMS SCADA database, DOMA function	Checking real-time data	Due to DIS inability to find a solution, AdvancedDistributionAutomationSystem is initiated.	DMS SCADA database	DOMA function	Command to initiate AdvancedDistributionAutomationSystem, DMS real-time analog, status & TLQ data		Intra-Control Center
2.4.4b		OutageManagementSystem, DOMA function	Checking real-time data	DOMA function receives the scan of latest schedules of presently active or authorized for future outages to be checked for changes.	OutageManagementSystem	DOMA function	Schedules of presently active or authorized for future outages		Intra-Control Center
2.4.5b		EnergyManagementSystem SCADA database, DOMA function	Checking real-time data	DOMA function receives the scan of EnergyManagementSystem SCADA data to be checked for relevant changes or events.	EnergyManagementSystem SCADA database	DOMA function	EnergyManagementSystem real-time analog, status, TLQ data		Intra-Control Center
2.4.6b		Environmental daily data collector, DOMA function	Checking real-time data	DOMA function receives the scan of environmental data to be checked for changes affecting DER schedule forecast.	Environmental daily data collector	DOMA function	Real-time environmental data for DER schedule forecast		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.4.7b		Fault location function, DOMA function	Checking real-time data	DOMA function receives the distance to fault location, which is provided by fault-locating relay in the presence of the fault.	Fault location function	DOMA function	Distance to fault location		Intra-Control Center
2.4.8b		DOMA function, ADATopology UpdateSystem	ADATopologyUpdateSystem changes connectivity	After DOMA detects fault in distribution, relevant information is provided to topology function.	DOMA function	ADATopologyUpdateSystem	Circuit breaker lockouts, inputs from OutageManagementSystem		Intra-Control Center
2.4.9b		ADATopology UpdateSystem, ADADatabase	ADATopologyUpdateSystem changes connectivity	After fault is detected, AdvancedDistributionAutomationSystem database is updated.	ADATopologyUpdateSystem	ADADatabase	Update of AdvancedDistributionAutomationSystem database		Intra-Control Center
2.4.10b		ADATopology UpdateSystem, FLIR function	Fault location subfunction identifies fault-related protective devices and de-energized sections	Topology function initiates fault location sub-function of the FLIR function.	ADATopologyUpdateSystem	FLIR function	Fault location subfunction initiation		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.4.11b		ADADatabase, FLIR function	Fault location subfunction identifies fault-related protective devices and de-energized sections	Fault location subfunction receives the needed data from AdvancedDistributionAutomationSystem database after it was updated with fault information.	ADADatabase	FLIR function	Excerpts from AdvancedDistributionAutomation System database updated after fault detection		Intra-Control Center
2.4.12b		FLIR function	Fault isolation and service restoration sub-function generates list of recommended switching orders	Fault location subfunction initiates fault isolation and service restoration sub-function of the FLIR function.	Fault location function	Fault isolation and service restoration subfunction	Fault isolation and service restoration sub-function initiation, probable fault location with alternatives		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.4.13b		ADADatabase, FLIR function	Fault isolation and service restoration sub-function generates list of recommended switching orders	Fault isolation and service restoration sub-function receives AdvancedDistributionAutomationSystem database excerpts updated with fault information.	ADADatabase	FLIR function	AdvancedDistributionAutomationSystem database excerpts		Intra-Control Center
2.4.14b		FLIR function, ADAHistoricDatabase	Fault isolation and service restoration sub-function generates list of recommended switching orders	FLIR issues a report for archiving in AdvancedDistributionAutomationSystem historic database.	FLIR function	ADAHistoricDatabase	Report including interrupted, un-served and restored load, and number of customers before additional fault isolation		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.4.15b		FLIR function, Regional System Operator	Fault isolation and service restoration sub-function generates list of recommended switching orders	A list of recommended switching orders is presented to the Regional System Operator.	FLIR function	Regional System Operator	List of switching orders recommended after fault detection		User Interface
2.4.16b		Regional System Operator, DMS SCADA database	SO execution	In the advisory mode, the Regional System Operator, after reviewing SO, issues a supervisory command to execute it.	Regional System Operator	DMS SCADA database	Supervisory command to execute SO issued after fault detection		User Interface
2.4.17b		Regional System Operator, field crew	Regional System Operator informs field crew	Regional System Operator authorizes to patrol the faulted line to accurately locate fault.	Regional System Operator	FieldPersonnel	Authorization to patrol faulted line		User Interface

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.4.18b		FieldPersonnel, Regional System Operator	FieldPersonnel informs Regional System Operator	After locating the fault, the crew informs the Regional System Operator about the status of switches involved in additional switching to isolate the smallest possible faulted section.	FieldPersonnel	Regional System Operator	Status of switches involved in isolating the smallest possible faulted section		User Interface
2.4.19b, 2.4.20b		Regional System Operator, ADADatabase	Entering status of switches and faulted section into AdvancedDistributionAutomationSystem database	The Regional System Operator enters status of switches (pseudo-statuses) involved in final fault isolation and the faulted section into AdvancedDistributionAutomationSystem database.	Regional System Operator	ADADatabase	AdvancedDistributionAutomationSystem database update additional fault isolation		User Interface
2.4.21b		Regional System Operator, FLIR	Entering status of switches and faulted section into AdvancedDistributionAutomationSystem database	Entering the faulted section into AdvancedDistributionAutomationSystem database initiates FLIR	ADADatabase	FLIR	Fault isolation and service restoration sub-function initiation after additional fault isolation		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.4.22b		ADADatabase, FLIR function	Fault isolation and service restoration sub-function generates list of recommended switching orders	Fault isolation and service restoration sub-function receives AdvancedDistributionAutomationSystem database excerpts updated after additional fault isolation.	ADADatabase	FLIR function	AdvancedDistributionAutomationSystem database excerpts		Intra-Control Center
2.4.23b		FLIR function, ADAHistoricDatabase	Fault isolation and service restoration sub-function generates list of recommended switching orders	FLIR issues a report for archiving in AdvancedDistributionAutomationSystem historic database.	FLIR function	ADAHistoric Database	Report including interrupted, un-served and restored load, and number of customers after additional fault isolation		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.4.24b		FLIR function, Regional System Operator	Fault isolation and service restoration sub-function generates list of recommended switching orders	A list of recommended switching orders is presented to the Regional System Operator.	FLIR function	Regional System Operator	List of switching orders recommended after additional fault isolation		User Interface
2.4.25b		Regional System Operator, DMS SCADA database	SO execution	The Regional System Operator, after reviewing SO, issues a supervisory command to execute it, if remotely controlled switches are used. If manual switches are involved, the Regional System Operator dispatches the crew to implement the switching order.	Regional System Operator	DMS SCADA database	Supervisory command to execute SO issued after additional fault isolation; instructions for the crew.		User Interface

2.2.2.5 FLIR Fault with DER Connected to Healthy Section

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
#	*Triggering event? Identify the name of the event.*[11]	*What other actors are primarily responsible for the Process/Activity? Actors are defined in section1.5.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information? Actors are defined in section1.5.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section1.5.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*
2.5.1	Fault in a circuit with DER connected to healthy section cleared by fast circuit breaker trip and by reverse protection from DER fault injection creating a self-sufficient island	DMS SCADA database, relay protection schemes, historic database	Unintentional self-sufficient island is created	DOMA receives the scan of DMS SCADA data and historic load data to be checked for changes in topology and loading during the time of repair.	DMS SCADA database	DOMA	DMS real-time analog, status & TLQ data, phasor data from WAMACS		Intra-Control Center

[11] Note – A triggering event is not necessary if the completion of the prior step – leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.5.2a		DOMA	Checking the sufficiency of the island during the time of repair	DOMA determines the sufficiency of the island during the time of repair and enables FLIR for location of the fault within the de-energized section.	DOMA	FLIR	Instructions to FLIR		Intra-Control Center
2.5.2b		DOMA	Checking the sufficiency of the island during the time of repair	DOMA determines the insufficiency of the island during the portion of time of repair and enables FLIR for location of the fault within the de-energized section and solving restoration for the customers connected to the island.	DOMA	FLIR	Instructions to FLIR		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.5.3	Fault in a circuit with DER connected to healthy section cleared by fast circuit breaker trip and by reverse protection from DER fault injection, creating an insufficient island	DMS SCADA database, relay protection schemes, historic database	Unintentional insufficient island is created, DER is separated with or without balanced load	DOMA receives the scan of DMS SCADA data and historic load data to be checked for changes in topology and loading during the time of repair.	DMS SCADA database	DOMA	DMS real-time analog, status & TLQ data, phasor data from WAMACS		Intra-Control Center
2.5.4		DOMA	Checking the sufficiency of the island during the time of repair	DOMA determines the insufficiency of the island during the time of repair and enables FLIR for location of the fault within the de-energized section and solving restoration for the de-energized customers connected to the island.	DOMA	FLIR	Instructions to FLIR		Intra-Control Center

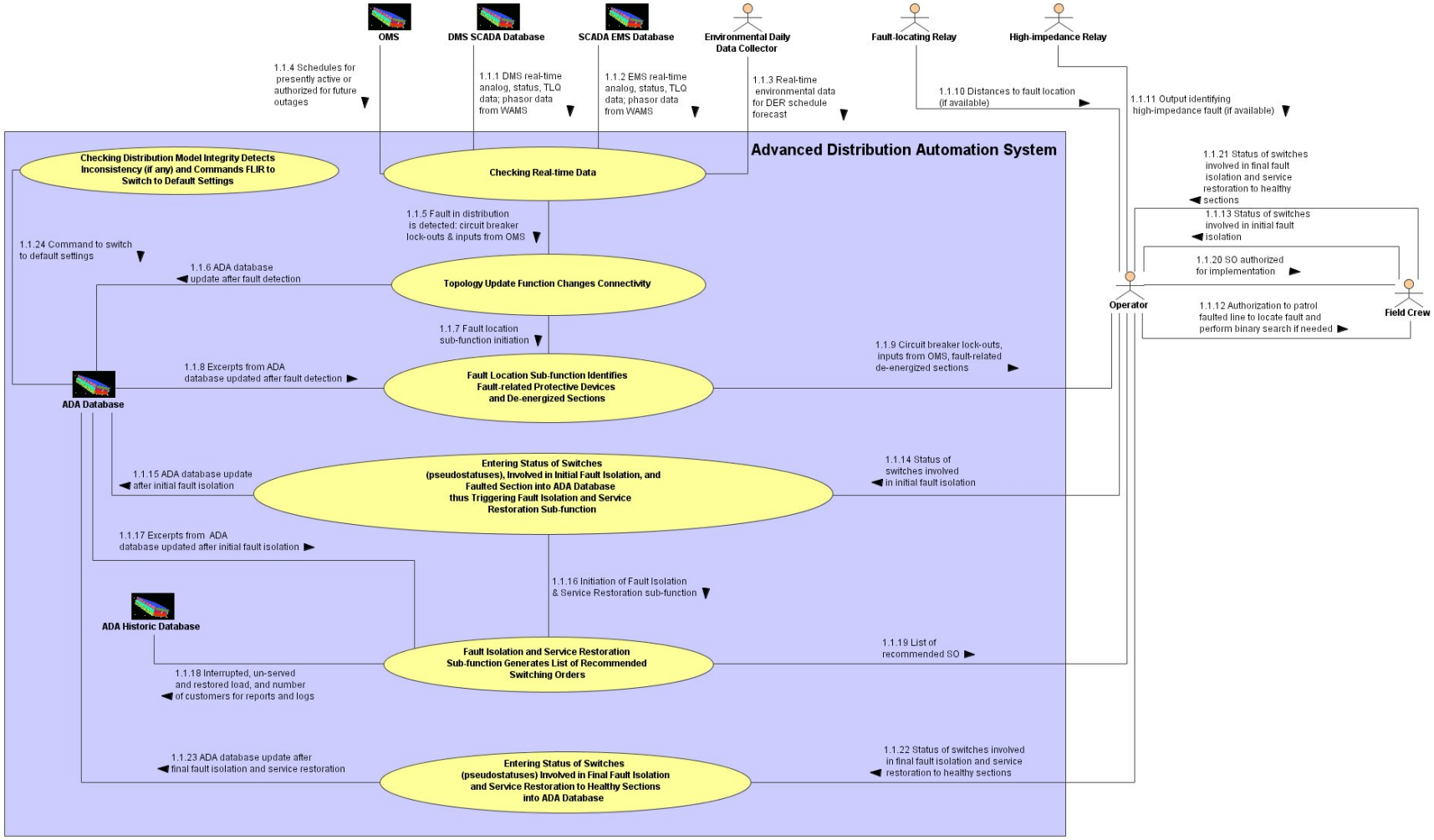
#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
2.5.5	Fault in a circuit with DER connected to healthy section cleared by circuit breaker and by relay protection of DER at the PCC	DMS SCADA database, relay protection schemes, historic database	The feeder is de-energized, DER is separated with or without balanced load	DOMA receives the scan of DMS SCADA data and historic load data to be checked for changes in topology and loading during the time of repair.	DMS SCADA database	DOMA	DMS real-time analog, status & TLQ data, phasor data from WAMACS		Intra-Control Center
2.5.6		DOMA	Checking the topology to ensure that DER is sepaarted	DOMA determines the after-fault topology, the loading during the time of repair, and enables FLIR for location of the fault and solving isolation of the fault and restoration for the de-energized customers connected to the healthy portions of the feeder.	DOMA	FLIR	Instructions to FLIR		Intra-Control Center

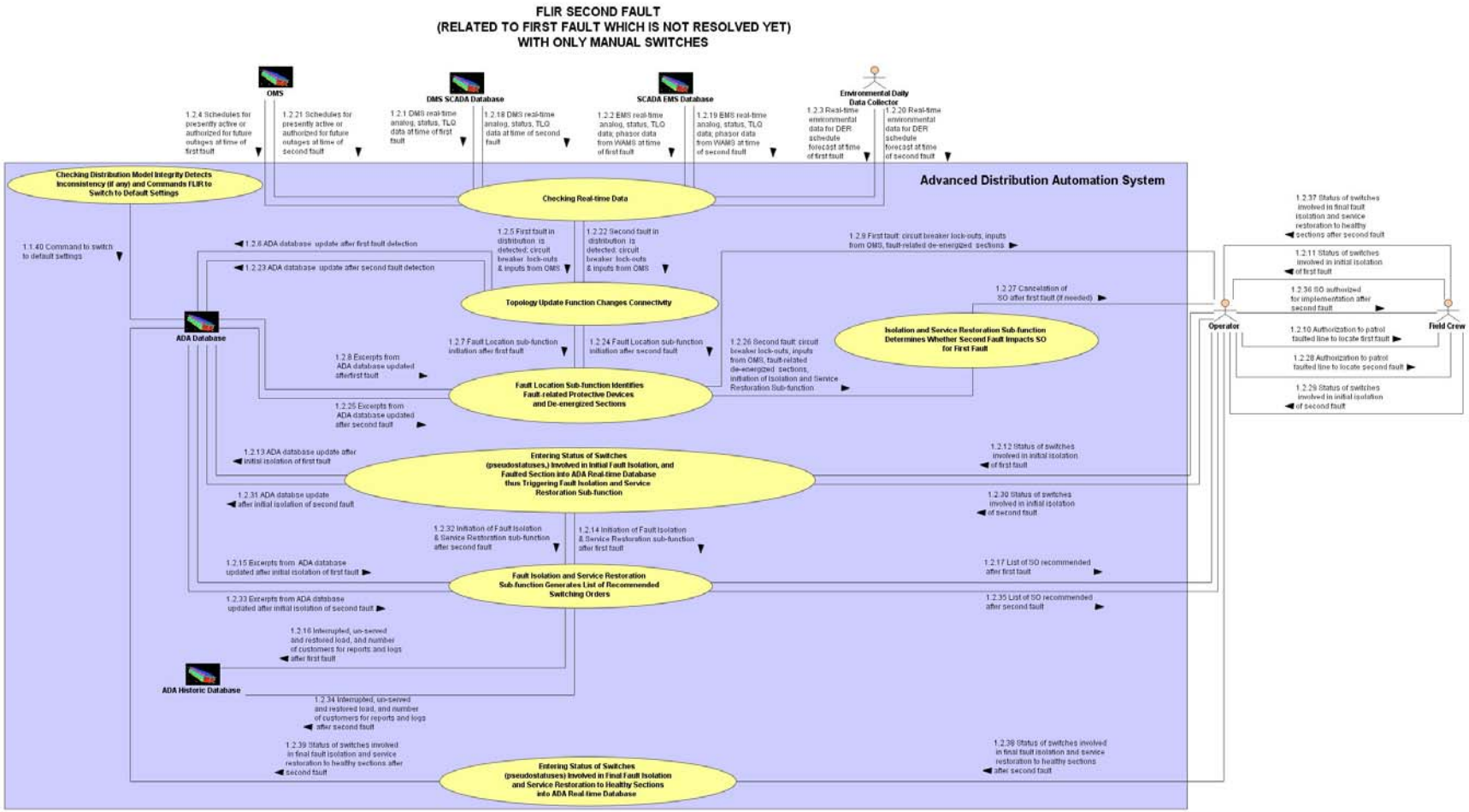
2.3.1 Post-conditions and Significant Results

Actor/Activity	*Post-conditions Description and Results*
AdvancedDistributionAutomationSystem: Fault location function, Isolation and Restoration	Faulted section is identified. A solution for an optimal isolation of faulted portions of distribution feeder and restoration of services to healthy portions is provided to the operator; closed-loop execution of switching orders is available; outage time for the majority of customers is reduced to several minutes.

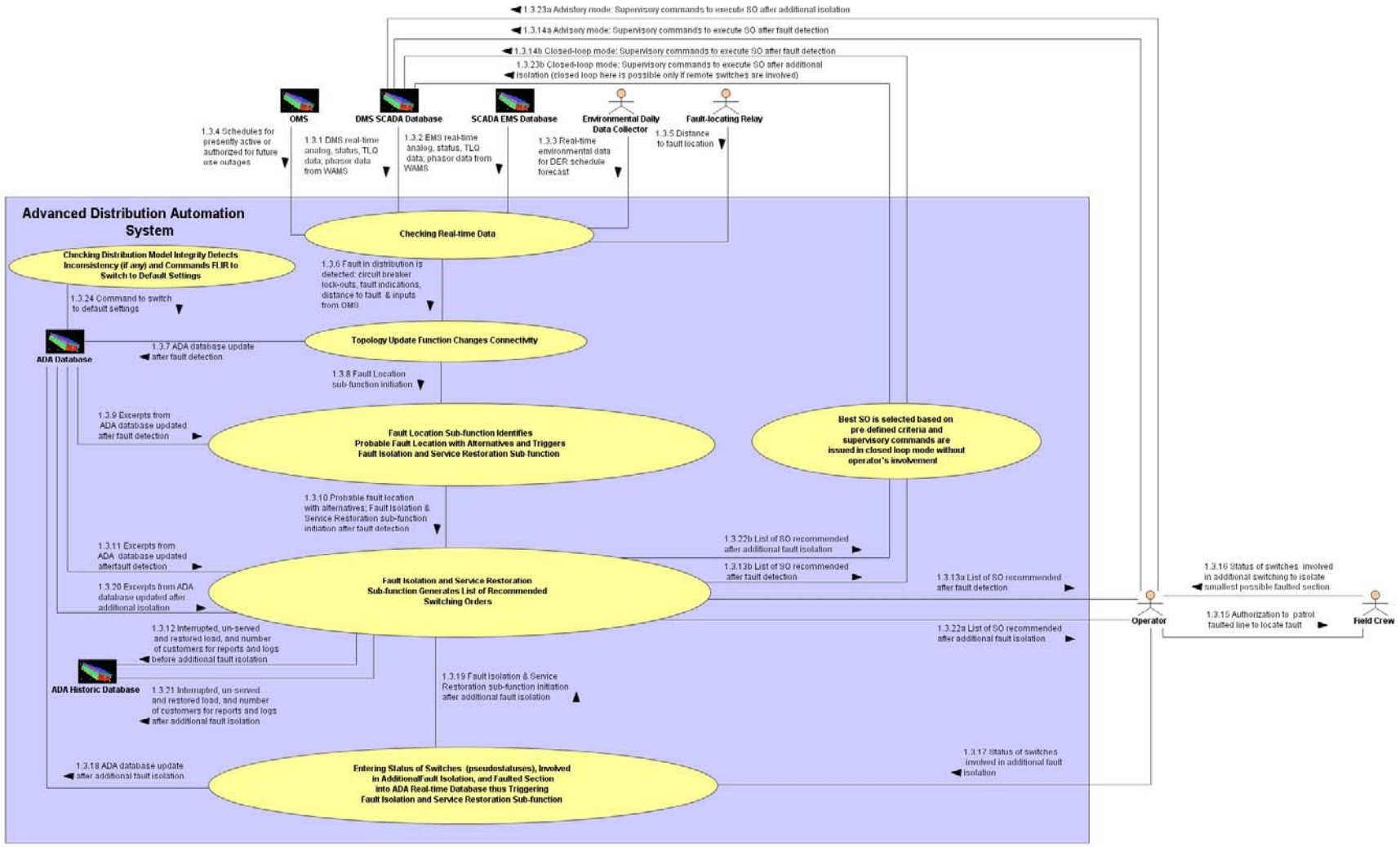
2.3.2 Diagrams

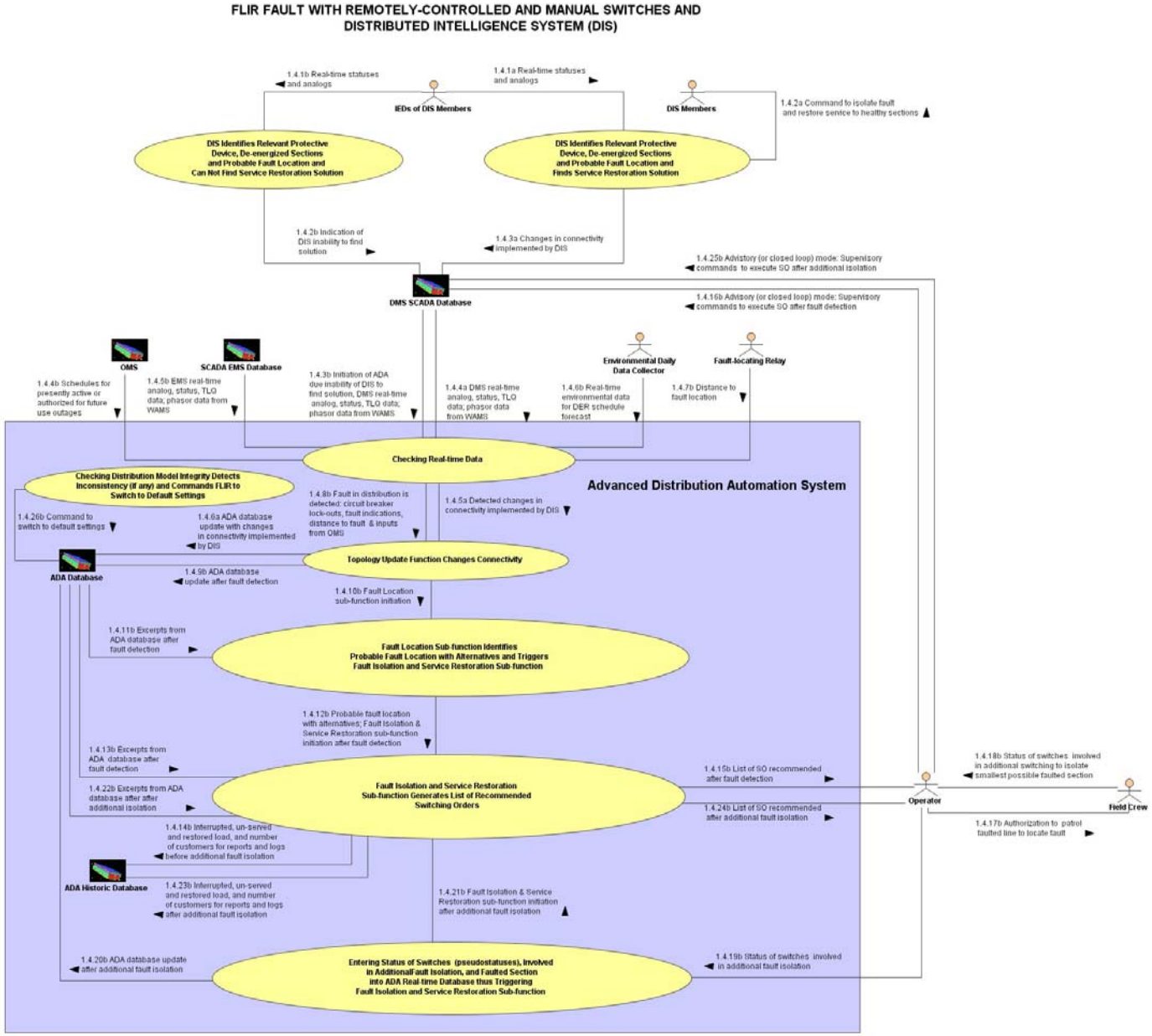
FLIR FIRST FAULT WITH ONLY MANUAL SWITCHES

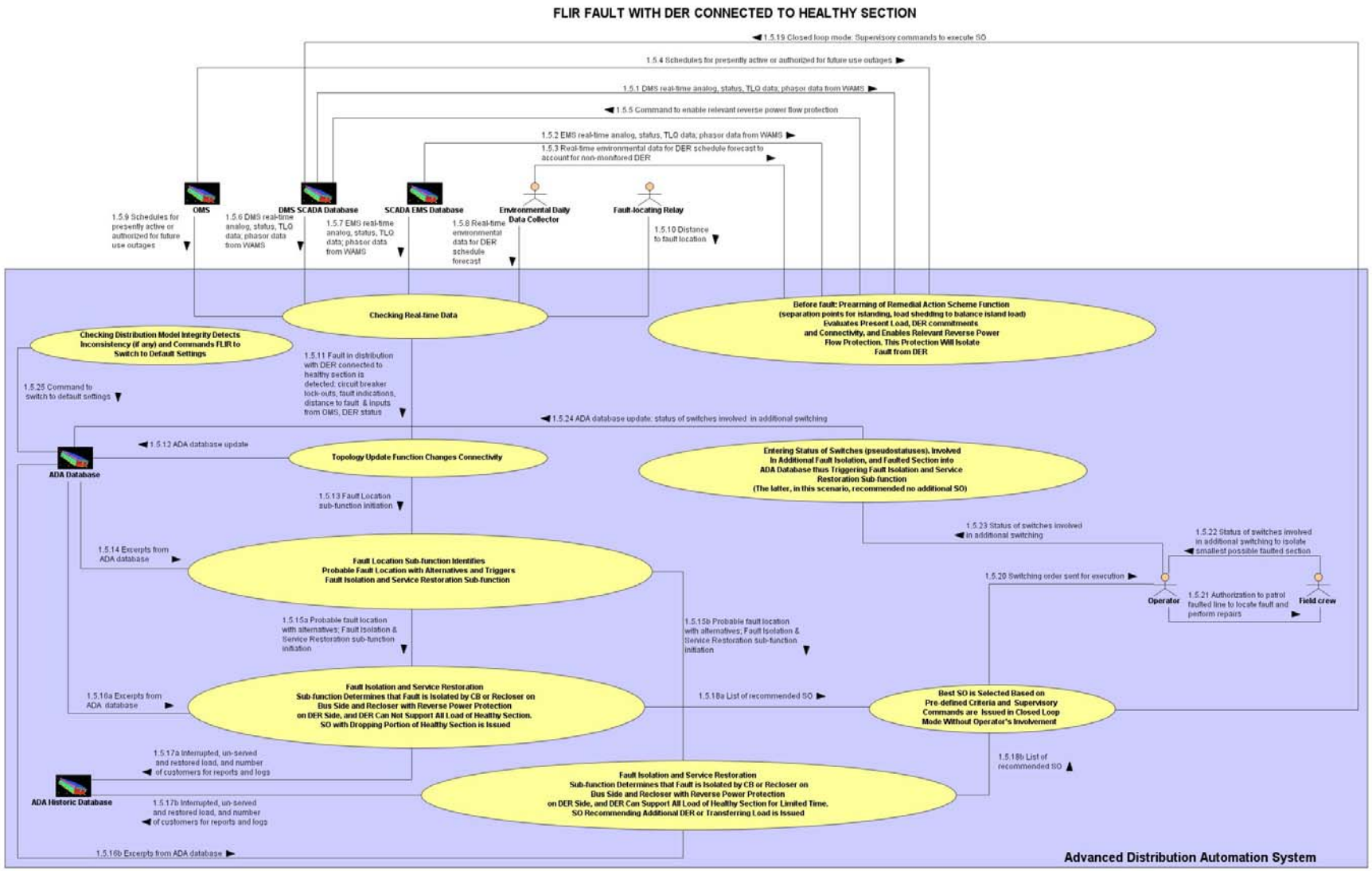



FLIR SECOND FAULT
(RELATED TO FIRST FAULT WHICH IS NOT RESOLVED YET)
WITH ONLY MANUAL SWITCHES
OMS
DMS SCADA Database
SCADA EMS Database
Environmental Data Collector
Advanced Distribution Automation System
Checking Distribution Model Integrity Detects Inconsistency (if any) and Commands FLIR to Switch to Default Settings
Checking Real-time Data
Topology Update Function Changes Connectivity
Isolation and Service Restoration Sub-function Determines Whether Second Fault Impacts SO for First Fault
Fault Location Sub-function Identifies Fault-related Protective Devices and De-energized Sections
Entering Status of Switches (pseudostatuses,) Involved in Initial Fault Isolation, and Faulted Section into ADA Real-time Database thus Triggering Fault Isolation and Service Restoration Sub-function
Fault Isolation and Service Restoration Sub-function Generates List of Recommended Switching Orders
Entering Status of Switches (pseudostatuses) Involved in Final Fault Isolation and Service Restoration to Healthy Sections into ADA Real-time Database
ADA Database
ADA Historic Database
Operator
Field Crew
1.2.4 Schedules for presently active or authorized for future outages at time of first fault
1.2.21 Schedules for presently active or authorized for future outages at time of second fault
1.2.1 DMS real-time analog, status, TLQ data at time of first fault
1.2.18 DMS real-time analog, status, TLQ data at time of second fault
1.2.2 EMS real-time analog, status, TLQ data; phasor data from WAMS at time of first fault
1.2.19 EMS real-time analog, status, TLQ data; phasor data from WAMS at time of second fault
1.2.3 Real-time environmental data for DER schedule forecast at time of first fault
1.2.20 Real-time environmental data for DER schedule forecast at time of second fault
1.1.40 Command to switch to default settings
1.2.6 ADA database update after first fault detection
1.2.23 ADA database update after second fault detection
1.2.5 First fault in distribution is detected; circuit breaker lock-outs & inputs from OMS
1.2.22 Second fault in distribution is detected; circuit breaker lock-outs & inputs from OMS
1.2.9 First fault: circuit breaker lock-outs, inputs from OMS, fault-related de-energized sections
1.2.27 Cancelation of SO after first fault (if needed)
1.2.7 Fault Location sub-function initiation after first fault
1.2.24 Fault Location sub-function initiation after second fault
1.2.26 Second fault: circuit breaker lock-outs, inputs from OMS, fault-related de-energized sections, initiation of Isolation and Service Restoration Sub-function
1.2.8 Excerpts from ADA database updated after first fault
1.2.25 Excerpts from ADA database updated after second fault
1.2.13 ADA database update after initial isolation of first fault
1.2.12 Status of switches involved in initial isolation of first fault
1.2.31 ADA database update after initial isolation of second fault
1.2.30 Status of switches involved in initial isolation of second fault
1.2.32 Initiation of Fault Isolation & Service Restoration sub-function after second fault
1.2.14 Initiation of Fault Isolation & Service Restoration sub-function after first fault
1.2.15 Excerpts from ADA database updated after initial isolation of first fault
1.2.17 List of SO recommended after first fault
1.2.33 Excerpts from ADA database updated after initial isolation of second fault
1.2.35 List of SO recommended after second fault
1.2.16 Interrupted, un-served and restored load, and number of customers for reports and logs after first fault
1.2.34 Interrupted, un-served and restored load, and number of customers for reports and logs after second fault
1.2.39 Status of switches involved in final fault isolation and service restoration to healthy sections after second fault
1.2.38 Status of switches involved in final fault isolation and service restoration to healthy sections after second fault
1.2.37 Status of switches involved in final fault isolation and service restoration to healthy sections after second fault
1.2.11 Status of switches involved in initial isolation of first fault
1.2.36 SO authorized for implementation after second fault
1.2.10 Authorization to patrol faulted line to locate first fault
1.2.28 Authorization to patrol faulted line to locate second fault
1.2.29 Status of switches involved in initial isolation of second fault

FLIR FAULT WITH REMOTELY-CONTROLLED AND MANUAL SWITCHES




FLIR FAULT WITH REMOTELY-CONTROLLED AND MANUAL SWITCHES AND DISTRIBUTED INTELLIGENCE SYSTEM (DIS)
1.4.1b Real-time statuses and analogs
1.4.1a Real-time statuses and analogs
IEDs of DIS Members
DIS Members
1.4.2a Command to isolate fault and restore service to healthy sections
DIS Identifies Relevant Protective Device, De-energized Sections and Probable Fault Location and Can Not Find Service Restoration Solution
DIS Identifies Relevant Protective Device, De-energized Sections and Probable Fault Location and Finds Service Restoration Solution
1.4.2b Indication of DIS inability to find solution
1.4.3a Changes in connectivity implemented by DIS
1.4.25b Advisory (or closed loop) mode: Supervisory commands to execute SO after additional isolation
DMS SCADA Database
1.4.16b Advisory (or closed loop) mode: Supervisory commands to execute SO after fault detection
OMS
SCADA EMS Database
Environmental Daily Data Collector
Fault-locating Relay
1.4.4b Schedules for presently active or authorized for future use outages
1.4.5b EMS real-time analog, status, TLO data; phasor data from WAMS
1.4.3b Initiation of ADA due inability of DIS to find solution, DMS real-time analog, status, TLO data; phasor data from WAMS
1.4.4a DMS real-time analog, status, TLO data; phasor data from WAMS
1.4.6b Real-time environmental data for DER schedule forecast
1.4.7b Distance to fault location
Checking Real-time Data
Advanced Distribution Automation System
Checking Distribution Model Integrity Detects Inconsistency (if any) and Commands FLIR to Switch to Default Settings
1.4.8b Fault in distribution is detected: circuit breaker lock-outs, fault indications, distance to fault & inputs from OMS
1.4.5a Detected changes in connectivity implemented by DIS
1.4.26b Command to switch to default settings
1.4.6a ADA database update with changes in connectivity implemented by DIS
ADA Database
Topology Update Function Changes Connectivity
1.4.9b ADA database update after fault detection
1.4.10b Fault Location sub-function initiation
1.4.11b Excerpts from ADA database after fault detection
Fault Location Sub-function Identifies Probable Fault Location with Alternatives and Triggers Fault Isolation and Service Restoration Sub-function
1.4.12b Probable fault location with alternatives; Fault Isolation & Service Restoration sub-function initiation after fault detection
1.4.13b Excerpts from ADA database after fault detection
1.4.22b Excerpts from ADA database after after additional isolation
Fault Isolation and Service Restoration Sub-function Generates List of Recommended Switching Orders
1.4.15b List of SO recommended after fault detection
1.4.24b List of SO recommended after additional fault isolation
Operator
Field Crew
1.4.18b Status of switches involved in additional switching to isolate smallest possible faulted section
1.4.17b Authorization to patrol faulted line to locate fault
1.4.14b Interrupted, un-served and restored load, and number of customers for reports and logs before additional fault isolation
ADA Historic Database
1.4.23b Interrupted, un-served and restored load, and number of customers for reports and logs after additional fault isolation
1.4.21b Fault Isolation & Service Restoration sub-function initiation after additional fault isolation
1.4.20b ADA database update after additional fault isolation
Entering Status of Switches (pseudostatuses), Involved in AdditionalFault Isolation, and Faulted Section into ADA Real-time Database thus Triggering Fault Isolation and Service Restoration Sub-function
1.4.19b Status of switches involved in additional fault isolation


FLIR FAULT WITH DER CONNECTED TO HEALTHY SECTION
1.5.19 Closed loop mode: Supervisory commands to execute SO
1.5.4 Schedules for presently active or authorized for future use outages
1.5.1 DMS real-time analog, status, TLO data; phasor data from WAMS
1.5.5 Command to enable relevant reverse power flow protection
1.5.2 EMS real-time analog, status, TLO data; phasor data from WAMS
1.5.3 Real-time environmental data for DER schedule forecast to account for non-monitored DER
OMS
DMS SCADA Database
SCADA EMS Database
Environmental Daily Data Collector
Fault-locating Relay
1.5.9 Schedules for presently active or authorized for future use outages
1.5.6 DMS real-time analog, status, TLO data; phasor data from WAMS
1.5.7 EMS real-time analog, status, TLO data; phasor data from WAMS
1.5.8 Real-time environmental data for DER schedule forecast
1.5.10 Distance to fault location
Checking Real-time Data
Before fault: Prearming of Remedial Action Scheme Function (separation points for islanding, load shedding to balance island load) Evaluates Present Load, DER commitments and Connectivity, and Enables Relevant Reverse Power Flow Protection. This Protection Will Isolate Fault from DER
Checking Distribution Model Integrity Detects Inconsistency (if any) and Commands FLIR to Switch to Default Settings
1.5.11 Fault in distribution with DER connected to healthy section is detected: circuit breaker lock-outs, fault indications, distance to fault, & inputs from OMS, DER status
1.5.25 Command to switch to default settings
1.5.24 ADA database update: status of switches involved in additional switching
1.5.12 ADA database update
ADA Database
Topology Update Function Changes Connectivity
Entering Status of Switches (pseudostatuses), Involved In Additional Fault Isolation, and Faulted Section into ADA Database thus Triggering Fault Isolation and Service Restoration Sub-function (The latter, in this scenario, recommended no additional SO)
1.5.13 Fault Location sub-function initiation
1.5.23 Status of switches involved in additional switching
1.5.22 Status of switches involved in additional switching to isolate smallest possible faulted section
1.5.14 Excerpts from ADA database
Fault Location Sub-function Identifies Probable Fault Location with Alternatives and Triggers Fault Isolation and Service Restoration Sub-function
1.5.20 Switching order sent for execution
Operator
1.5.21 Authorization to patrol faulted line to locate fault and perform repairs
Field crew
1.5.15a Probable fault location with alternatives; Fault Isolation & Service Restoration sub-function initiation
1.5.15b Probable fault location with alternatives; Fault Isolation & Service Restoration sub-function initiation
1.5.16a Excerpts from ADA database
Fault Isolation and Service Restoration Sub-function Determines that Fault is Isolated by CB or Recloser on Bus Side and Recloser with Reverse Power Protection on DER Side, and DER Can Not Support All Load of Healthy Section. SO with Dropping Portion of Healthy Section is Issued
1.5.18a List of recommended SO
Best SO is Selected Based on Pre-defined Criteria and Supervisory Commands are Issued in Closed Loop Mode Without Operator's Involvement
1.5.18b List of recommended SO
1.5.17a Interrupted, un-served and restored load, and number of customers for reports and logs
ADA Historic Database
1.5.17b Interrupted, un-served and restored load, and number of customers for reports and logs
Fault Isolation and Service Restoration Sub-function Determines that Fault is Isolated by CB or Recloser on Bus Side and Recloser with Reverse Power Protection on DER Side, and DER Can Support All Load of Healthy Section for Limited Time. SO Recommending Additional DER or Transferring Load is Issued
1.5.16b Excerpts from ADA database
Advanced Distribution Automation System

2.3 Volt/Var Control function (VVC)

2.3.1 VVC Preconditions and Assumptions

Describe conditions that must exist prior to the initiation of the Function, such as prior state of the actors and activities

Identify any assumptions, such as what systems already exist, what contractual relations exist, and what configurations of systems are probably in place

Identify any initial states of information exchanged in the steps in the next section. For example, if a purchase order is exchanged in an activity, its precondition to the activity might be 'filled in but unapproved'.

Actor/System/Information/Contract	*Preconditions or Assumptions*
EnergyManagementSystem SCADA	EnergyManagementSystem system contains the transmission power system model, and can provide the transmission connectivity information for facilities in the vicinity of the distribution power system facilities and with outputs from other EnergyManagementSystem applications
DMS SCADA database	DistributionSCADASystem database is updated via remote monitoring and operator inputs.. Required scope, speed, and accuracy of real-time measurements are provided, supervisory and closed-loop control is supported.
ADADistributionOperationModeling and Analysis (DOMA)	**Preconditions:** DistributionSCADASystem with several IEDs along distribution feeders, reporting statuses of remotely controlled switches and analogs including Amps, kW, kvar, and kV. Regional System Operator's ability for updating the SCADA database with statuses of switches not monitored remotely. Substation SCADA with analogs and statuses from CBs exists. EnergyManagementSystem is interfaced with AdvancedDistributionAutomationSystem. AdvancedDistributionAutomationSystem database is updated with the latest AM/FM and CIS data and operators input. The options for DOMA performance are selected
AdvancedDistributionAutomationSystem: Fault Location Isolation and Service Restoration (FLIR)	Fault Location **Preconditions:** DistributionSCADASystem with fault detectors, Distribution Operation Model and Analysis with fault analysis, fault location relays (schemes) including high impedance relays and Some Distributed Intelligence schemes and Trouble call system exist. Fault Isolation and Service Restoration **Preconditions:** DistributionSCADASystem with ability to control a defined number of switching devices, Fault Location, Distribution Operation Model and Analysis, Voltage and Var Control for adjusting voltage and var after reconfiguration. Supervisory and closed-loop control of switches are available. Some Distributed Intelligence schemes exist.
OutageManagementSystem	Outage Management System is interfaced with SCADA and AdvancedDistributionAutomationSystem and supports a dynamic topology model.
EnergyManagementSystem (WAMACS)	EnergyManagementSystem is interfaced with WAMACS and AdvancedDistributionAutomationSystem and provides phasor data for all distribution (reference) buses.
Regional System Operator	Regional System Operator has AdvancedDistributionAutomationSystem GUI and uses it for supervisory control of switches, for entering pseudo-SCADA statuses, selecting isolation and

Actor/System/Information/Contract	*Preconditions or Assumptions*
	restoration alternatives, etc. The operator also has the ability to communicate with the field crews via mobile communications and computing.
AdvancedDistributionAutomationSystem: Prearming of Remedial Action Schemes function	AdvancedDistributionAutomationSystem is interfaced with the RAS schemes with the capability of changing the priorities of RAS actions and settings.
ADAHistoricDatabase	Historic database is able to store large amount of data about outages, which will be used by the outage statistic application and other users.
AdvancedDistributionAutomationSystem: MFR function	Multi-feeder reconfiguration function with ability to optimally select feeder(s) connectivity for a given objective.

2.3.2 VVC Steps – Normal Sequence

Describe the normal sequence of events, focusing on steps that identify new types of information or new information exchanges or new interface issues to address. Should the sequence require detailed steps that are also used by other functions, consider creating a new "sub" function, then referring to that "subroutine" in this function. Remember that the focus should be less on the algorithms of the applications and more on the interactions and information flows between "entities", e.g. people, systems, applications, data bases, etc. There should be a direct link between the narrative and these steps.

The numbering of the sequence steps conveys the order and concurrency and iteration of the steps occur. Using a Dewey Decimal scheme, each level of nested procedure call is separated by a dot '.'. Within a level, the sequence number comprises an optional letter and an integer number. The letter specifies a concurrent sequence within the next higher level; all letter sequences are concurrent with other letter sequences. The number specifies the sequencing of messages in a given letter sequence. The absence of a letter is treated as a default 'main sequence' in parallel with the lettered sequences.

Sequence 1:

```
1.1 - Do step 1
1.2A.1 - In parallel to activity 2 B do step 1
1.2A.2 - In parallel to activity 2 B do step 2
1.2B.1 - In parallel to activity 2 A do step 1
1.2B.2 - In parallel to activity 2 A do step 2
1.3 - Do step 3
1.3.1 - nested step 3.1
1.3.2 - nested step 3.2
```

Sequence 2:

2.1 - Do step 1
2.2 – Do step 2

2.3.2.1 VVC Function During Scheduled Run

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
#	*Triggering event? Identify the name of the event.*[12]	*What other actors are primarily responsible for the Process/Activity? Actors are defined in section1.5.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information? Actors are defined in section1.5.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section1.5.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*
3.1.1	Time for ADAVVC Controller scheduled run	DMS SCADA database, DOMA function	Checking real-time data	DOMA function receives the scan of DMS SCADA data to be checked for changes in topology. It also receives the latest relevant analog data.	DMS SCADA database	DOMA function	DMS real-time analog, status & TLQ data, status of voltage controllers, DER modes of operation, and settings		Intra-Control Center

[12] Note – A triggering event is not necessary if the completion of the prior step – leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
3.1.2		EnergyManagementSystem SCADA database, DOMA function	Checking real-time data	DOMA function receives the scan of EnergyManagementSystem SCADA data to be checked for relevant changes or events.	EnergyManagementSystem SCADA database	DOMA function	EnergyManagementSystem real-time analog, status, TLQ data		Intra-Control Center
3.1.3		DOMA function, ADAVVCController	VVC performs optimization according to current objective	The fact that no events and changes in connectivity are detected is communicated to ADAVVCController. ADAVVCController is triggered by the time schedule.	DOMA function	ADAVVCController	No events or changes in connectivity detected, command to start scheduled run		Intra-Control Center
3.1.4		ADADatabase, ADAVVCController	VVC performs optimization according to current objective	VVC receives the excerpts from AdvancedDistributionAutomationSystem database.	ADADatabase	ADAVVCController	Excerpts from AdvancedDistributionAutomationSystem database		Intra-Control Center
3.1.5		ADAVVCController, Regional System Operator	VVC performs optimization according to current objective	Relevant results of VVC optimization are displayed for the Regional System Operator.	ADAVVCController	Regional System Operator	VVC status, present and recommended bus kV, benefits, expected lowest and highest load voltage		User Interface

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
3.1.6		ADAVVCController, DMS SCADA database	VVC performs optimization according to current objective	Relevant results of VVC optimization are sent to controllers in the field.	ADAVVCController	DMS SCADA database	Recommended settings to relevant voltage and power electronic controllers, DER modes of operation and settings, capacitor status		Intra-Control Center
3.1.7		ADAVVCController, ADAHistoricDatabase	VVC performs optimization according to current objective	Relevant results of VVC optimization are stored in AdvancedDistributionAutomationSystem historic database.	ADAVVCController	ADAHistoricDatabase	VVC and LTC states and settings; VVC limits and benefits; losses, voltage, objective function and total demand before and after optimization, logs		Intra-Control Center
3.1.8		DMS SCADA database, DOMA function	Checking real-time data	DOMA function receives the scan of DMS SCADA data to be checked for changes in topology and confirmation of execution of VVC commands. It also provides the latest relevant analog data.	DMS SCADA database	DOMA function	DMS real-time analog, status & TLQ data, status of voltage controllers, confirmation of execution of VVC commands		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
3.1.9		DMS SCADA database, ADAVVCController	Information for Regional System Operator	Regional System Operator's display is regularly updated with data associated with LTC and VVC performance.	DMS SCADA database	ADAVVCController	VVC: status, integrity, settings, limits, bandcenter, objective; LTC: status, position; bus voltage limits		Intra-Control Center

2.3.2.2 VVC Function During Event Run

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
#	*Triggering event? Identify the name of the event.*[13]	*What other actors are primarily responsible for the Process/Activity? Actors are defined in section1.5.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information? Actors are defined in section1.5.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section1.5.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*

[13] Note – A triggering event is not necessary if the completion of the prior step – leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
3.2.1-1	ADA VVC Controller during event run	DOMA function	DOMA detects load voltage or overload violation	DOMA function detects load voltage or overload violation and initiates ADAVVCController.	DOMA function	ADAVVCController	Command to initiate VVC		Intra-Control Center
3.2.1-11, 3.2.1-111, 3.2.1-1111		DMS SCADA database, DOMA function	Checking real-time data	DOMA function checks the real-time data for changes, alarms.	DMS SCADA database	DOMA function	DMS real-time analog, status, TLQ data, confirmation of execution of VVC commands, status of voltage controllers		Intra-Control Center
3.2.1-12, 3.2.1-112, 3.2.1-1112		SCADA EnergyManagementSystem database, DOMA function	Checking real-time data	DOMA function checks the real-time data for changes, alarms.	SCADA EnergyManagementSystem database	DOMA function	EnergyManagementSystem real-time analog, status, TLQ data		Intra-Control Center
3.2.1.13		DOMA function, ADAVVCController	Changing current objective to load reduction within normal limits due to high energy price	DOMA function detects high-energy price and issues command to change VVC objective.	DOMA function	ADAVVCController	Command to change optimization objective		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
3.2.1.14		DOMA function, ADAVVCController	VVC performs optimization according to current objective	DOMA function issues command to initiate VVC.	DOMA function	ADAVVCController	Command to initiate VVC		Intra-Control Center
3.2.2		ADAVVCController, ADADatabase	VVC performs optimization according to current objective	ADAVVCController receives excerpt from AdvancedDistributionAutomationSystem database updated with latest SCADA scan.	ADADatabase	ADAVVCController	AdvancedDistributionAutomationSystem database excerpt		Intra-Control Center
3.2.3		ADAVVCController, Regional System Operator	VVC performs optimization according to current objective	VVC issues information relevant for Regional System Operator.	ADAVVCController	Regional System Operator	VVC status, present and recommended bus kV, benefits, expected lowest and highest load voltages		User Interface
3.2.4		ADAVVCController, DMS SCADA database	VVC performs optimization according to current objective	DMS SCADA database receives results of optimization.	ADAVVCController	DMS SCADA database	Recommended settings to relevant voltage and power electronic controllers, DER modes of operation and settings, capacitor status		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
3.2.5		ADAVVCController, ADAHistoricDatabase	VVC performs optimization according to current objective	Selected results are archived in ADAHistoricDatabase.	ADAVVCController	ADAHistoricDatabase	VVC and LTC states and settings; VVC limits and benefits; losses, voltage, objective function and total demand before and after optimization, logs		Intra-Control Center
3.2.6		ADAVVCController, DOMA function	VVC performs optimization according to current objective	ADAVVCController initiates DOMA function after confirmation of execution is received.	ADAVVCController	DOMA function	Command to initiate DOMA		Intra-Control Center
3.2.7		DOMA function, Regional System Operator	DOMA function performs analysis	DOMA function, after detecting a violation present during the after-optimization conditions, sends alarm to Regional System Operator.	DOMA function	Regional System Operator	Alarm for Regional System Operator		User Interface

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
3.2.8		DOMA function, Remedial Action Scheme, Regional System Operator	Prearming RAS function adjusts settings of relevant groups of load shedding	DOMA function, after detecting that optimization has not eliminated transmission violation, sends an alarm to the Regional System Operator and triggers pre-arming of RAS.	DOMA function	Remedial Action Scheme, Regional System Operator	Information for prearming Remedial Action Scheme		User Interface
3.2.9		DMS SCADA database, Regional System Operator	Data for Regional System Operator	Relevant for Regional System Operator VVC and LTC settings, limits and statuses are displayed.	DMS SCADA database	Regional System Operator	VVC: status, integrity, settings, limits, bandcenter, objective LTC: status, position		User Interface
3.3.1		DOMA function, ADAVVCController	VVC determines violation can not be eliminated through optimization	DOMA function detects load voltage or voltage violation.	DOMA function	ADAVVCController	Command to initiate VVC		Intra-Control Center
3.3.2		ADADatabase, ADAVVCController	VVC determines violation can not be eliminated through optimization	VVC receives excerpts from AdvancedDistributionAutomationSystem database updated with latest SCADA scan.	ADADatabase	ADAVVCController	Excerpts from AdvancedDistributionAutomationSystem database		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
3.3.3		ADAVVCController, MFR function	VVC determines violation can not be eliminated through optimization	VVC initiates MFR to eliminate the violation.	ADAVVCController	MFR function	Command to initiate MFR		Intra-Control Center
3.3.4		ADAVVCController, ADAHistoricDatabase	VVC determines violation can not be eliminated through optimization	AdvancedDistributionAutomationSystem historic database receives logs issued by VVC.	ADAVVCController	ADAHistoricDatabase	Logs		Intra-Control Center
3.4.1		DOMA function, ADAVVCController	DOMA function detects distribution model inconsistency	After detecting distribution model inconsistency, DOMA function sets an inconsistency flag to put VVC in a default mode.	DOMA function	ADAVVCController	Distribution model inconsistency flag		Intra-Control Center
3.4.2		ADAVVCController, DMS SCADA database	VVC switches to default settings for portions of distribution system with inconsistent model	The fact that the VVC is switched to default setting has been issued is received by DMS SCADA database.	ADAVVCController	DMS SCADA database	Fact that VVC is switched to default setting		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
3.4.3		ADAVVCController, AdvancedDistributionAutomationSystem historic database	VVC switches to default settings for portions of distribution system with inconsistent model	Log is stored in AdvancedDistributionAutomationSystem historic database.	ADAVVCController	ADAHistoricDatabase	Log		Intra-Control Center
3.5.1		DMS SCADA database, DOMA function	Checking real-time data	DOMA function checks the real-time data for changes, alarms.	DMS SCADA database	DOMA function	DMS real-time analog, status, TLQ data, confirmation of execution of VVC commands, status of voltage controllers		Intra-Control Center
3.5.2		SCADA EnergyManagementSystem database, DOMA function	Checking real-time data	DOMA function checks the real-time data for changes, alarms.	SCADA EnergyManagementSystem database	DOMA function	EnergyManagementSystem real-time analog, status, TLQ data		Intra-Control Center
3.5.3		DOMA function, ADAVVCController	VVC determines there is room for optimization and performs optimization within emergency limits	DOMA detects transmission emergency limit violation and issues a command to initiate VVC.	DOMA function	ADAVVCController	Command to initiate VVC		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
3.5.4		ADADatabase, ADAVVCController	VVC determines there is room for optimization and performs optimization within emergency limits	VVC receives excerpts from AdvancedDistributionAutomationSystem database updated with latest SCADA scan.	ADADatabase	ADAVVCController	Excerpts from AdvancedDistributionAutomationSystem database		Intra-Control Center
3.5.5		ADAVVCController, Regional System Operator	VVC determines there is room for optimization and performs optimization within emergency limits	Selected optimization results are displayed for the Regional System Operator.	ADAVVCController	Regional System Operator	VVC status, present and recommended bus kV, expected lowest and highest load V, flag of using emergency limits		User Interface
3.5.6		ADAVVCController, DMS SCADA database	VVC determines there is room for optimization and performs optimization within emergency limits	DMS SCADA database receives relevant optimization results.	ADAVVCController	DMS SCADA database	Recommended settings to relevant voltage and power electronic controllers, DER modes of operation and settings, capacitors status		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
3.5.7		ADAVVCController, ADAHistoricDatabase	VVC determines there is room for optimization and performs optimization within emergency limits	Selected results are archived in AdvancedDistributionAutomationSystem historic database.	ADAVVCController	ADAHistoricDatabase	VVC and LTC states and settings; VVC limits and benefits; losses, voltage, objective function and total demand before and after optimization, logs		Intra-Control Center
3.5.8		ADAVVCController, DOMA function	VVC determines there is room for optimization and performs optimization within emergency limits	ADAVVCController initiates DOMA function after confirmation of execution is received.	ADAVVCController	DOMA function	Command to initiate DOMA		Intra-Control Center
3.5.9		DOMA function, Regional System Operator	DOMA function performs analysis	DOMA function, after detecting a violation present during the after-optimization conditions, sends alarm to Regional System Operator.	DOMA function	Regional System Operator	Alarm for Regional System Operator		User Interface

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
3.5.10		DOMA function, Prearming of RAS schemes function	Prearming RAS adjusts settings of relevant groups of load shedding	DOMA function, after detecting that optimization has not eliminated transmission violation, sends an alarm to pre-arming RAS function.	DOMA function	Prearming of RAS schemes function	Alarm for prearming RAS function		Intra-Control Center
3.5.11		DMS SCADA database, Regional System Operator	Data for Regional System Operator	Relevant for Regional System Operator VVC and LTC settings, limits, and statuses are displayed.	DMS SCADA database	Regional System Operator	VVC: status, integrity, settings, limits, bandcenter, objective LTC: status, position		User Interface

2.3.2.3 VVC Function Participation in Severe Emergency in Bulk Power System with Intentional Islands

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
#	*Triggering event? Identify the name of the event.*[14]	*What other actors are primarily responsible for the Process/Activity ? Actors are defined in section1.5.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information? Actors are defined in section1.5.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section1.5.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*

[14] Note – A triggering event is not necessary if the completion of the prior step – leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
3.6.1	The bulk power system is separated in near-balanced islands to prevent wide-area blackout. The load shedding schemes operated	Remedial Action Scheme, intentional islanding, Under-frequency load shedding (UFLS), Under-voltage load shedding, Special load shedding schemes	Creating transmission islands, and load-shedding by fast acting schemes	The conditions of capacity deficit are detected by EnergyManagement System/SCADA and submitted to VVC as a trigger for changing the objective and perform in emergency mode.	Transmission EnergyManagementSystem, Remedial Action Scheme.	AdvancedDistributionAutomationSystem load management functions	Command to initiate VVC in load reduction mode; commands from VVC to IEDs and DERs.		Intra-Control Center
3.6.2		SCADA EnergyManagementSystem database	Contingency in bulk power system creates transmission islands	SCADA EnergyManagement System receives status of switches (circuit breakers) in transmission affected by contingency.	Transmission EnergyManagementSystem, Remedial Action Scheme.	SCADA EnergyManagementSystem database	Status of switches		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
3.6.3		UFLS, DMS SCADA database	UFLS balances load and generation and changes distribution circuits connectivity	DMS SCADA database receives status of switches affected by load shedding.	FieldDevice	DMS SCADA database	Status of switches		Intra-Control Center
3.6.4		DMS SCADA database, DOMA function	Update of the topology and load models	DOMA function receives the latest scan of DMS SCADA database and adjusts the distribution operation model for VVC to perform in emergency load reduction mode. .	DMS SCADA database	DOMA function	DMS real-time analog, status, TLO data, status of voltage controllers.		Intra-Control Center
3.6.5		DOMA, ADAVVC Controller	Changing VVC current objective to load reduction within emergency limits	DOMA issues a command to change VVC objective and initiate optimization.	DOMA	ADAVVCController	Command to change VVC objective and optimization		Intra-Control Center

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environments
3.6.6		ADAVVC Controller	VVC performs optimization with emergency load reduction objective	VVC performs reduction of load not affected by load-shedding schemes to create capacity reserves and restore a portion of shed loads.	ADAVVCController	DMS SCADA database	Settings for voltage controllers, statuses of capacitors, power electronics statuses of DER, modes of operation and settings of DER controllers.		Intra-Control Center

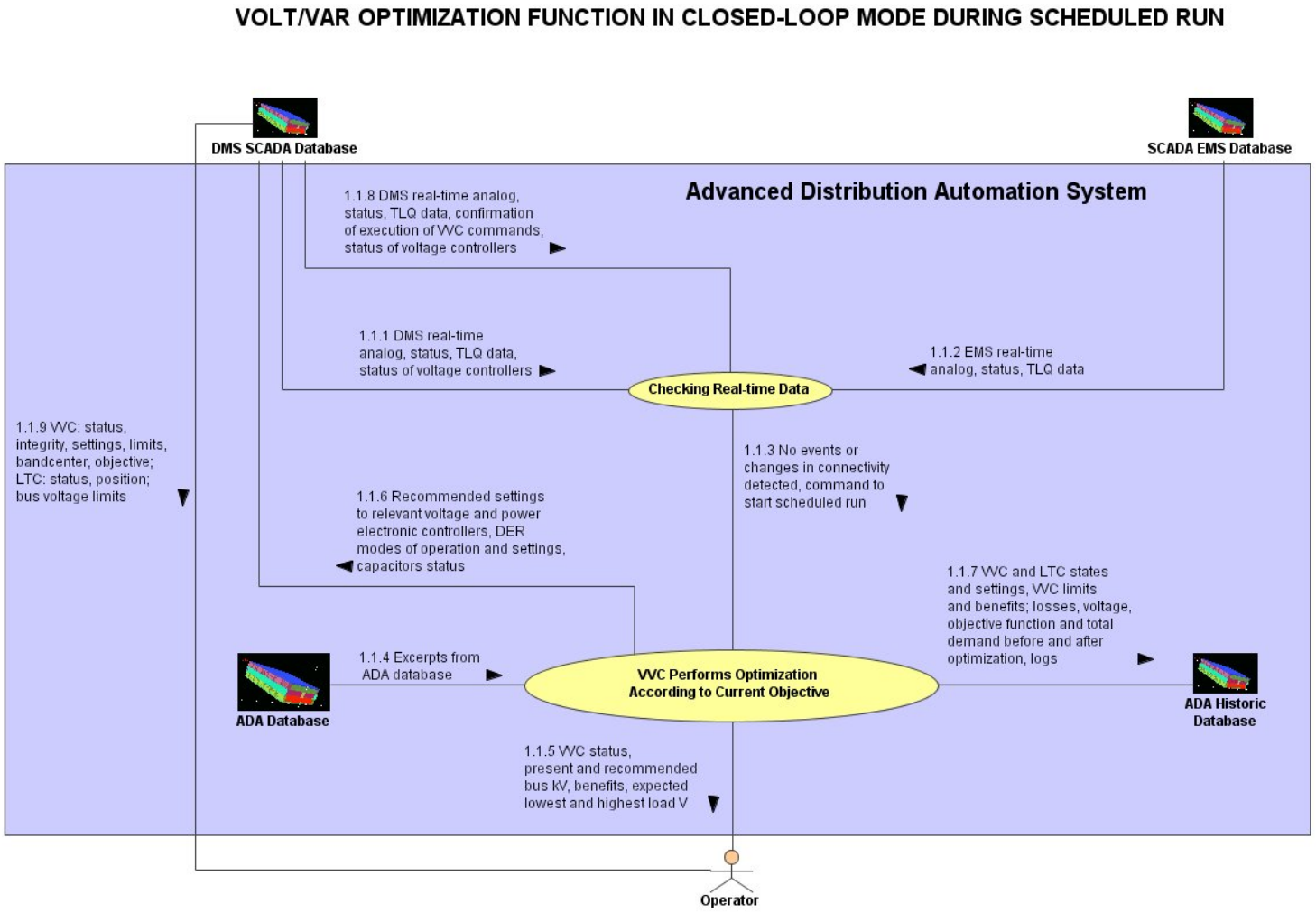
2.3.3 Post-conditions and Significant Results

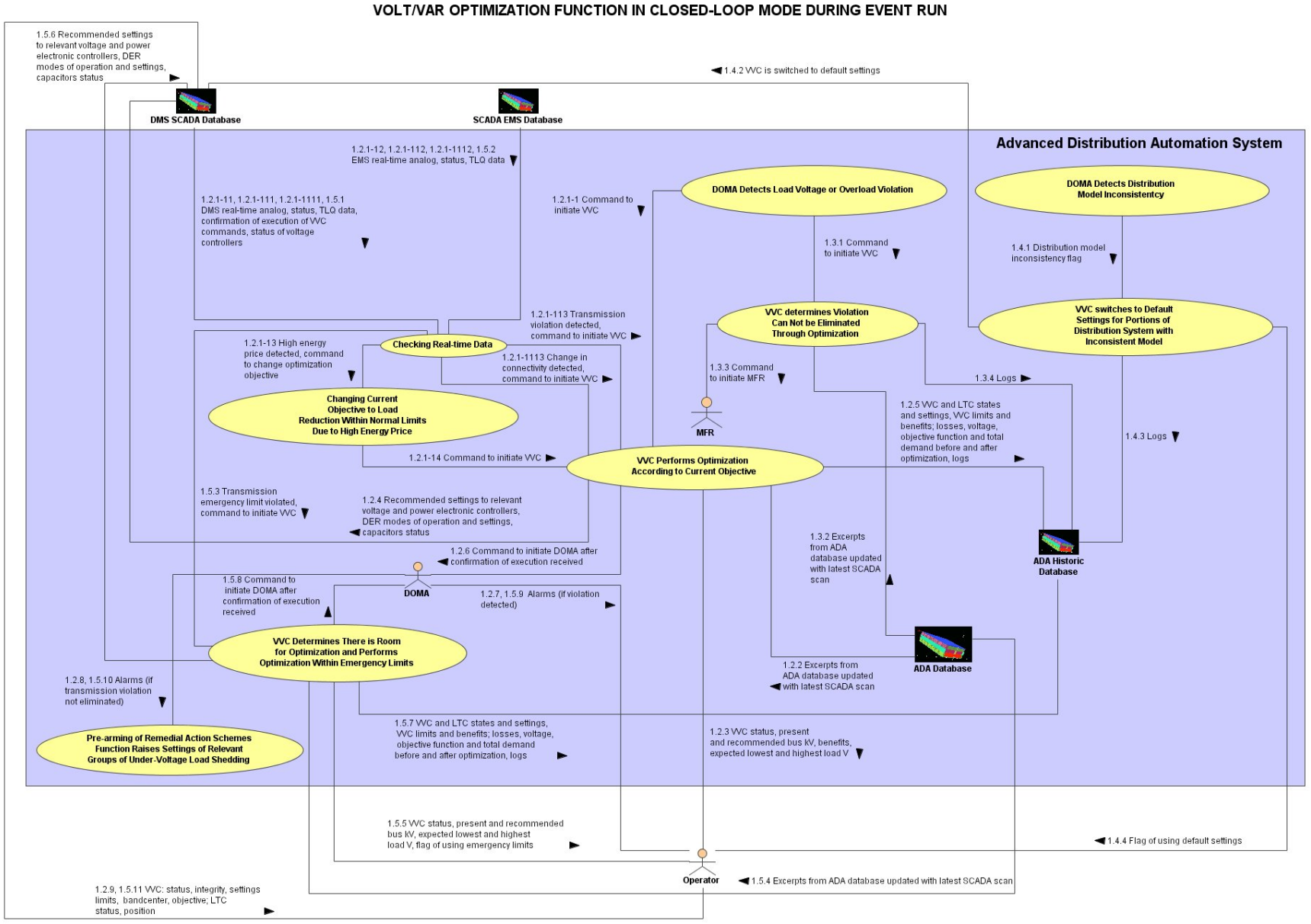
Describe conditions that must exist at the conclusion of the Function. Identify significant items similar to that in the preconditions section.

Describe any significant results from the Function

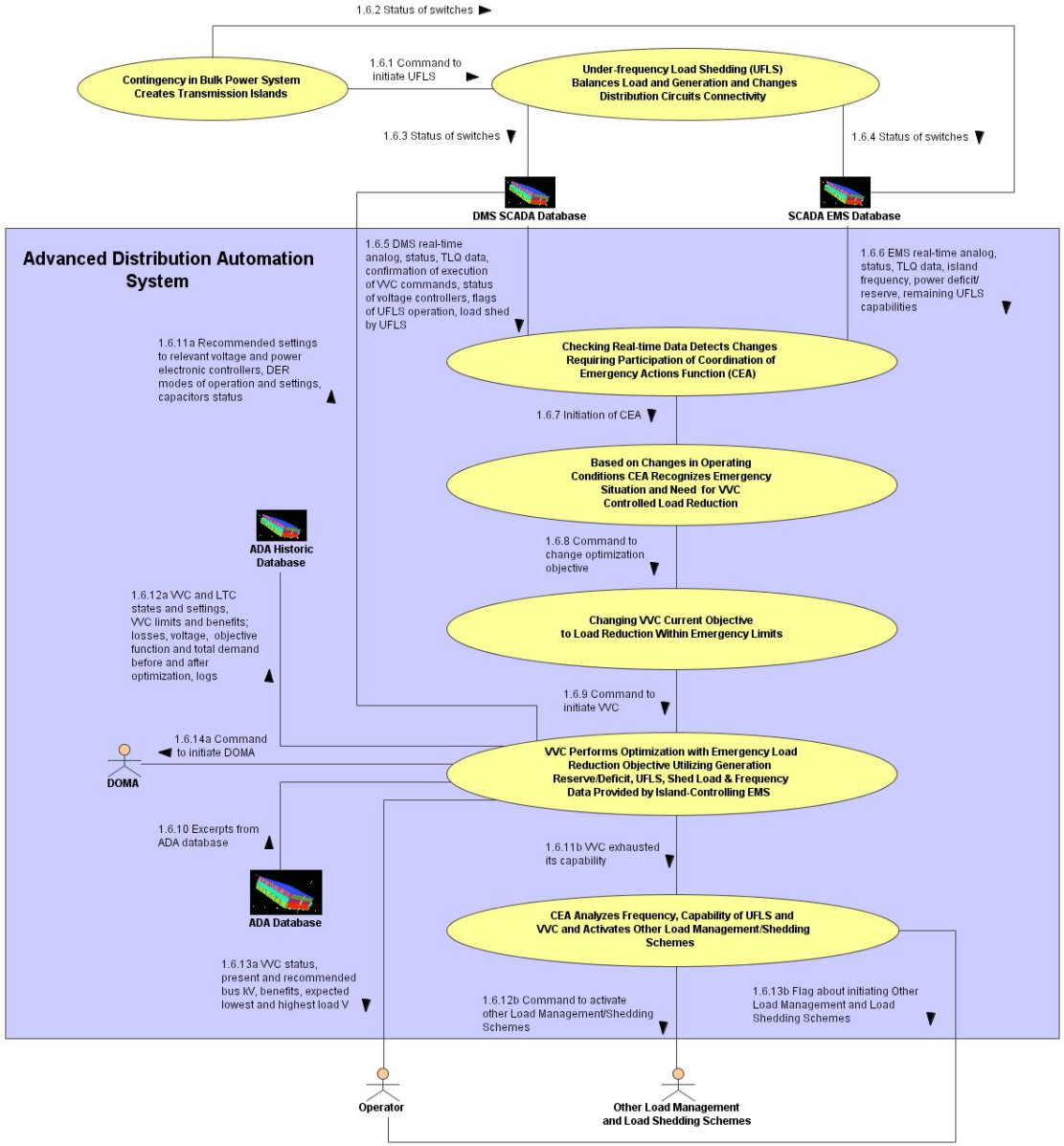
Actor/Activity	***Post-conditions Description and Results***
AdvancedDistributionAutomationSystem: Volt-var Control	Optimal voltage controller settings, capacitor statuses and DER modes of operation and settings, for a given objective(s) are sent to respective controllers. The power quality is enhanced. The distribution facilities are better utilized; the transmission and generation systems are better supported by volt and vars; the load management is less intrusive; the customers pay smaller bills.

2.3.4 Diagrams




VOLT/VAR OPTIMIZATION FUNCTION IN CLOSED-LOOP MODE DURING EVENT RUN
Advanced Distribution Automation System
1.5.6 Recommended settings to relevant voltage and power electronic controllers, DER modes of operation and settings, capacitors status
1.4.2 VVC is switched to default settings
DMS SCADA Database
SCADA EMS Database
1.2.1-12, 1.2.1-112, 1.2.1-1112, 1.5.2 EMS real-time analog, status, TLQ data
1.2.1-11, 1.2.1-111, 1.2.1-1111, 1.5.1 DMS real-time analog, status, TLQ data, confirmation of execution of VVC commands, status of voltage controllers
DOMA Detects Load Voltage or Overload Violation
1.2.1-1 Command to initiate VVC
DOMA Detects Distribution Model Inconsistency
1.3.1 Command to initiate VVC
1.4.1 Distribution model inconsistency flag
VVC determines Violation Can Not be Eliminated Through Optimization
VVC switches to Default Settings for Portions of Distribution System with Inconsistent Model
1.2.1-113 Transmission violation detected, command to initiate VVC
1.2.1-13 High energy price detected, command to change optimization objective
Checking Real-time Data
1.2.1-1113 Change in connectivity detected, command to initiate VVC
1.3.3 Command to initiate MFR
1.3.4 Logs
MFR
Changing Current Objective to Load Reduction Within Normal Limits Due to High Energy Price
1.2.5 VVC and LTC states and settings, VVC limits and benefits; losses, voltage, objective function and total demand before and after optimization, logs
1.4.3 Logs
1.2.1-14 Command to initiate VVC
VVC Performs Optimization According to Current Objective
1.5.3 Transmission emergency limit violated, command to initiate VVC
1.2.4 Recommended settings to relevant voltage and power electronic controllers, DER modes of operation and settings, capacitors status
1.3.2 Excerpts from ADA database updated with latest SCADA scan
ADA Historic Database
1.2.6 Command to initiate DOMA after confirmation of execution received
DOMA
1.5.8 Command to initiate DOMA after confirmation of execution received
1.2.7, 1.5.9 Alarms (if violation detected)
VVC Determines There is Room for Optimization and Performs Optimization Within Emergency Limits
ADA Database
1.2.2 Excerpts from ADA database updated with latest SCADA scan
1.2.8, 1.5.10 Alarms (if transmission violation not eliminated)
1.5.7 VVC and LTC states and settings, VVC limits and benefits; losses, voltage, objective function and total demand before and after optimization, logs
1.2.3 VVC status, present and recommended bus kV, benefits, expected lowest and highest load V
Pre-arming of Remedial Action Schemes Function Raises Settings of Relevant Groups of Under-Voltage Load Shedding
1.5.5 VVC status, present and recommended bus kV, expected lowest and highest load V, flag of using emergency limits
1.4.4 Flag of using default settings
Operator
1.5.4 Excerpts from ADA database updated with latest SCADA scan
1.2.9, 1.5.11 VVC: status, integrity, settings limits, bandcenter, objective; LTC status, position

VVC PARTICIPATION IN SEVERE EMERGENCY IN BULK POWER SYSTEM WITH INTENTIONAL ISLANDS



2.4 Architectural Issues in Interactions

Elaborate on all architectural issues in each of the steps outlined in each of the sequences above. Reference the Step by number..

2.5 Current Implementation Status

Describe briefly the current implementation status of the function and/or parts of it, referring to Steps above
Identify the key existing products, standards and technologies

Product/Standard/Technology	***Ref - Usage***
Eg. DNP 3	2.1.2.1[1] - Exchange of SCADA information

Current Implementations:

Relative maturity of function across industry:	***Ref - Status Discussion***
Very mature and widely implemented	**Discussion**
Moderately mature	
Fairly new	
Future, no systems, no interactions	

Existence of legacy systems involved in function:	***Ref - Status Discussion***
Many legacy systems	
Some legacy systems	
Few legacy systems	
No legacy systems	
Extensive changes will be needed for full functionality	
Moderate changes will be needed	
Few changes will be needed	

No changes will be needed

Implementation Concerns	*Ref - Status Discussion*
Data availability and accuracy	
Known and unknown market pressures	
Known and unknown technology opportunities	
Validation of capabilities of function	
Cost vs. benefit	

3 Auxiliary Issues

3.1 References and Contacts

Documents and individuals or organizations used as background to the function described; other functions referenced by this function, or acting as "sub" functions; or other documentation that clarifies the requirements or activities described. All prior work (intellectual property of the company or individual) or proprietary (non-publicly available) work must be so noted.

3.1.1 Prior Published Work of UCI and UCI's Personnel

The methodology and specification of the AdvancedDistributionAutomationSystem Function for current power system conditions have been developed, and prototype (pilot) and system-wide projects in several North-American utilities have been implemented by Utility Consulting International and its client utilities prior to the IECSA project.

1. Experience of System - Wide Distribution Automation At JEA, Don C. Gilbert, Nokhum Markushevich and Alex Fratkin, Distributech 2004 conference
2. Distribution Volt And Var Control In Emerging Business Environment, Nokhum Markushevich (UCI) and Ron Nielsen (B.C.Hydro), CEA Technologies Distribution Automation Seminar, Halifax, Nova Scotia, Canada. June, 2003
3. Strategic Operations of Distribution Systems in the Future, Nokhum Markushevich, Frances Cleveland, The DER/AdvancedDistributionAutomationSystem Project Stakeholder Team Formation Workshop, March 17-18, 2003

4. The Specifics Of Coordinated Real-Time Voltage And Var Control In Distribution, Nokhum S. Markushevich, Utility Consulting International (UCI), Distributech 2002 Conference
5. Distribution Automation Pilot Project Using the Utility Communications Architecture (UCA®) at City Public Service of San Antonio, EPRI , Palo Alto, CA: 2002. 1007066
6. Capacitor Control In Distribution Automation At OG&E, Aleksandr P. Berman, Nokhum S. Markushevich (UCI), and James C. Clemmer (OG&E), Distributech 2001 Conference
7. Performance Of Advanced DA Applications Implemented in JEA , Nokhum S. Markushevich (UCI), Charles J. Jensen (JEA), Alex I. Fratkin (UCI), and Jerry Knowles (JEA), Distributech 2001 Conference
8. Adaptive Control Of Multiple Protective Devices In The Distribution Automation System At JEA, Charles J. Jensen (JEA), Nokhum S. Markushevich and Aleksandr P. Berman (UCI), Distributech 2001 Conference,
9. Implementation Of Advanced Distribution Automation In Us Utilities, Nokhum S. Markushevich and Aleksandr P. Berman (Utility Consulting International), Charles J. Jensen (JEA), James C. Clemmer (OG&E), USA, CIRED Conference, Amsterdam, 2001
10. Advanced Network Applications In The Distribution Management System At City Public Service Of San Antonio, G. Hitzfelder (CPS), I. Roytelman, B. Nikolic, R. Horn (Siemens PT & D), N. Markushevich (UCI), Distributech 2001 Conference,
11. Implementation Of Advanced Distribution Automation At JEA And OG&E, Charles J. Jensen (JEA), James C. Clemmer (OG&E), Nokhum S. Markushevich (UCI), DA/DSM Distributech Conference, January 2000, Miami, Florida
12. Distribution Automation Pilot Projects At JEA And OG&E,. New Ideas For Remote Voltage And Var Control, Charles J. Jensen, James C. Clemmer Nokhum S. Markushevich, DA/DSM Distributech Conference, January 1999
13. Distribution Automation Project For The Peninsular Malaysian Distribution System, E. Chan, M Delson, N, Markushevich, K. Walston, Ir. T.A. Zaharuddin, and Jamal A. Nasir, CEPSI Conference, 1998.
14. Dynamic System Load Control through Use of Optimal Voltage and Var Control, Nokhum Markushevich, Ron E. Nelson, 1998 Dynamic Modeling Control Applications for Industry Workshop, IEEE Industry Application Society, 1998, Vancouver, Canada
15. Optimizing Feeder Sectionalizing Points for Distribution Automation, Charles Jensen, Nokhum Markushevich, Alex Berman, DA/DSM Distributech Conference, January 1998, Tampa, Florida.
16. Analysis of Capacitor Control Under Conditions of Distribution Automation at OG&E, Nokhum Markushevich, James Clemmer, Alex Berman, Alla Royz, DA/DSM Distributech Conference, January 1998, Tampa, Florida.
17. Distribution Automation Pilot Project at Georgia Power Company, , EPRI , Palo Alto, CA: 1997. TR-109486

18. The Impact of Simplification of the Distribution System Model on the Benefits of Voltage and Var Control, Nokhum Markushevich, Alex Berman, Dan Nordell, Craig Halverson; DA/DSM Distributech Conference, January 1997, San Diego, California.

19. Justification and Planning of Distribution Automation, Edward H.P. Chan, Nokhum S. Markushevich; CEPSI Conference, September 1996, Malaysia

20. Impact Of Automated Voltage/Var Control In Distribution On Power System Operations, Nokhum S. Markushevich, R.E. Nielsen, A.K. Nakamura, J.M. Hall, R.L. Nuelk; DA/DSM Conference January 1996, Tampa, Florida.

21. Update on DA Pilot Project at B.C. Hydro, Nokhum S. Markushevich Ron E. Nielsen, Fifth DA/DSM Conference January 1995, San Jose, California

22. Load to Voltage Dependency Tests at B.C. Hydro, Alf Dwyer, Ron Nielsen, Joerg Stangl, Nokhum S. Markushevich; IEEE/PES 1994 Summer Meeting, July 1994

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24. Planning a Distribution Automation Pilot Project at B.C. Hydro, Nokhum S. Markushevich, Martin Delson, Erik Benedictson, Alf Dwyer, Ivan Herejk, Carl Kober, Ron Nielsen, Joerg Stangl; DA/DSM Conference, January 1994, Florida

25. Integration Of Distribution Automation into Power System Operation, Edward H.P. Chan, Nokhum S. Markushevich; DA/DSM Conference, January 1994, Florida

26. Cost-Benefit Study for Distribution Automation at B.C. Hydro, Nokhum S. Markushevich, Ivan C. Herejk, Ron E. Nielsen ,Utility Consulting International, USA, , Distribution 2000 Conference, November 1993, Australia

27. Functional Requirements and Cost-Benefit Study for Distribution Automation at B.C. Hydro, Nokhum S. Markushevich, I.C. Herejk, Ron Nielsen, 1993 IEEE

28. Voltage and VAR Control in Automated Distribution Systems, Nokhum S. Markushevich; DA/DSM Conference, January 1993, Palm Springs, California

29. Intelligent Alarm Processing, Electric Power Research Institute (EPRI) TR-101576, Research Project #2944-04, Nokhum Markushevich, E.H. Chan, J. Birchfield. December 1992

30. Real Time Optimization of Power System Steady State Operating Conditions for Voltage and Reactive Power, N.B. Vladimirova, V.Costyushko, N.S. Markushevich, V.A. Timofeyev, N.P. Yemelyanov (USSR); CIGRE,September 1990

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32. Device for Automatic Voltage Control in Electric Networks, V.I. Zak, Nokhum S. Markushevich, Certificate of Invention, USSR # 1288816, 1985.

33. Voltage Control and Electric Energy Conservation, Nokhum S. Markushevich, Moscow: Energoatomizdat, 1984, pp.1-100. Sofia: Technika, 1987, pp. 1-84.

34. Automated Control of 6-20 kV Electric Network Operations, Nokhum S. Markushevich. Moscow: Energiya, 1980, pp. 1-208.

35. Device for Reactive Power Source Control, Nokhum S. Markushevich, Certificate of Invention USSR. # 922703, 1981.

36. Enhancement of the Authenticity of the Electric Network Power Flow Calculation, Nokhum S. Markushevich, Electrichestvo, # 12, 1979, pp. 1-5.

37. Voltage Quality in Urban Electric Networks, Nokhum S. Markushevich, L.A. Soldatkina. Moscow: Energiya, 1975, pp. 1-256

38. Automatic Frequency Load Shedding in USSR Power Systems, G.Boutin, N. Markushevich, M. Portnoy, at al. CIGRE, 34-04, 1972

39. Under-Frequency Load Shedding as a Means for Automatic Elimination of Emergencies, J.D. Barkan, Nokhum S. Markushevich, R.R. Rudzitis, V.N. Golubev, Electricheskie Stancii # 5, 1966, pp. 74-78.

40. Selective System of Automatic Reclosing after Automatic Frequency Load Shedding, Nokhum S. Markushevich, Electricheskie Stancii, #7 1964, pp. 71-73.

ID	Title or contact	Reference or contact information
[1]		
[2]		

3.2 Action Item List

As the function is developed, identify issues that still need clarification, resolution, or other notice taken of them. This can act as an Action Item list.

ID	Description	Status
	Distribution Operation Modeling and Analysis (DOMA)	Developed by UCI; specified by UCI for development by DMS vendors; Partially developed by Siemens and is under development by ALSTOM based on UCI specification. Needs additional development for distribution with significant penetration of DER and power electronics, and for looped

		distribution. EMS applications should be modified to utilize the output from DOMA
2	Fault Location, Isolation and Service Restoration (FLIR)	Developed by UCI and also by Siemens; specified by UCI for development by DMS vendors; is under development by ALSTOM based on UCI specification. Needs additional development for distribution with significant penetration of DER and power electronics, for looped distribution, and for new technological advances in fault anticipation and location.
3	Contingency Analysis (CA)	Developed by UCI. Needs additional development for distribution with significant penetration of DER and power electronics and for looped distribution.
4	Multi-level Feeder Reconfiguration (MFR)	Developed by UCI and also by Siemens; specified by UCI for development by DMS vendors; is under development by ALSTOM based on UCI specification. Needs additional development for distribution with significant penetration of DER and power electronics.
5	Relay Protection Re-coordination (RPR)	Developed by UCI. Needs additional development for distribution with significant penetration of DER and power electronics and for looped distribution.
6	Voltage and Var Control (VVC)	Developed by UCI; specified by UCI for development by DMS vendors. Based on UCI specification, developed by Siemens and is under development by ALSTOM. Needs additional development for distribution with significant penetration of DER and power electronics and for looped distribution. EMS network analysis functions and emergency control function should be modified and interfaced with VVC
7	Prearming of Remedial Action Schemes (RAS)	Needs to be developed and interfaces with the emergency control function of EMS and with intelligent RAS
8	Coordination of emergency actions	Needs to be developed and interfaces with the emergency control function of EMS and with intelligent RAS
9	Coordination of restorative actions	Needs to be developed and interfaces with the emergency control function of EMS and with intelligent RAS
10	Intelligent Alarm Processing	Needs to be developed for distribution with

		AdvancedDistributionAutomationSystem/DER.

3.3 Revision History

For reference and tracking purposes, indicate who worked on describing this function, and what aspect they undertook.

No	Date	Author	Description
01.	10/16/03	Nokhum Markushevich, Mark Lachman	Draft 01 prepared. Needs more formatting.
02	10/19	Frances Cleveland	Review 2.1,Revised 2.4, added Fig.2
0.3	10/20	Nokhum Markushevich	Revised 2.1, edited Fig. 2
0.4	10/21	Nokhum Markushevich	Amended 2.4 and Fig.1
05	10/29	Nokhum Markushevich	Added X.8 to 2.3 and amended 2.4 with more details for X.7 and with X.8.
06	11/7	Frances Cleveland	Reorganized and elaborated on functions
06		Mark Lachman	Reorganized and elaborated on functions
07	12/09	Nokhum Markushevich	Revised the elaborated functions, added Fig.2.1
08	02/29/04	Mark Lachman Nokhum Markushevich	Developed UMS diagrams, added power point illustrations and clarifications, revised the step-by-step descriptions of the sub-functions.

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