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Group 1 for the Plant Spatial Configuration STEP Application Protocol

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ABSTRACT

Part 227 of ISO 10303, *Plant Spatial Configuration*, specifies an application protocol (AP) for the exchange of spatial configuration information of process plants. This includes shape characteristics, spatial arrangement characteristics, and design and fabrication information for piping system components, and functional and stream information for piping and HVAC (heating, ventilating, and air conditioning) systems. Also included are shape and spatial arrangement characteristics of other related plant systems that impact the design and layout of piping systems.

This document specifies the scope and information requirements for AP 227 and provides the Application Activity Model (AIM) and Application Reference Model (ARM) for the AP. The document follows the format and clause numbering scheme prescribed for this type of International Organization for Standardization (ISO) standard. The clauses and annexes contained in this document are those required by ISO for Group 1 qualification. Additional clauses and annexes will be added to the AP during the completion of the standard.

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PREFACE

Industry and government require comprehensive and reliable information exchange mechanisms to effectively integrate computer-aided (CAx) systems and evolving information technologies. Subcommittee Four (Industrial data and global manufacturing programming languages) of the International Organization for Standardization (ISO) Technical Committee 184 (Industrial automation systems and integration), ISO TC184/SC4, is preparing ISO 10303, a set of international standards titled *Industrial automation systems and integration - Product data representation and exchange*. The set of proposed standards is informally known as STEP (STandard for the Exchange of Product model data).

ISO 10303 will provide a neutral mechanism for describing product data throughout the life cycle of a product, independent of any particular CAx system. ISO 10303 is suitable for file exchange and for implementing, sharing, and archiving product databases. The development of ISO 10303 is based upon the use of information models, a framework for product data modelling, formal data specification languages, and an architecture that separates information requirements from implementation methods.

A fundamental concept of STEP is the definition of application protocols (APs) as the mechanism for specifying information requirements and for ensuring reliable communication. An **application protocol** is a Part of ISO 10303 that defines the context, scope, and information requirements for designated application(s) and specifies the resource constructs used to satisfy these requirements. The scope of an AP is defined by the type of product, the supported stages in the life cycle of the product, the required types of product data, the uses of the product data, and the disciplines that use the product data. Additionally, an AP enumerates the conformance requirements for conformance testing of implementations of the AP.

All proposed Parts for STEP are subject to a qualification process by the Working Group (WG) Four STEP Part Qualification and Validation Project (QVP). An AP is divided into two groups for the formal qualification by the QVP. Group 1 includes the scope (Clause 1), definitions (Clause 3), information requirements (Clause 4), application activity model (AAM) (Annex F), application reference model (ARM) (Annex G), and the initial conformance classes (Clause 6). Group 2 includes the normative references (Clause 2), application interpreted model (AIM) (Clause 5), the AIM annexes, the completed conformance requirements (Clause 6), and all remaining annexes of the AP.

Part 227 of ISO 10303, *Plant Spatial Configuration*, specifies an AP for the exchange of spatial configuration information of process plants. This document constitutes the Group 1 documentation for AP 227. As such, it does not include Clause 5 and the Group 2 annexes discussed above.

The *Plant Spatial Configuration Application Protocol* is proceeding through the ISO development and approval process.

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Foreword

This part of ISO 10303 has been prepared by Sub-committee 4 (Industrial data and global manufacturing programming languages) of ISO Technical Committee 184 (Industrial automation systems and integration).

This is the first edition of this part of ISO 10303.

The following annexes are normative: A, B, C, D.

The following annexes are informative: E, F, G, H.

This is one in a series of parts which together form the International Standard ISO 10303 - Industrial automation systems and integration - Product data representation and exchange. The other parts are as follows:

— Part 1 Overview and fundamental principles;

— Part 11 Description methods: The EXPRESS language reference manual;

— Part 21 Implementation methods: Clear text encoding of the exchange structure;

— Part 22 Implementation methods: Standard data access interface;

— Part 31 Conformance testing methodology and framework: General concepts;

— Part 32 Conformance testing methodology and framework: Requirements on testing laboratories and clients;

— Part 41 Integrated generic resources: Fundamentals of product description and support;

— Part 42 Integrated generic resources: Geometric and topological representation;

— Part 43 Integrated generic resources: Representation structures;

— Part 44 Integrated generic resources: Product structure configuration;

— Part 45 Integrated generic resources: Materials;

— Part 46 Integrated generic resources: Visual presentation;

— Part 47 Integrated generic resources: Shape variation tolerances;

— Part 49 Integrated generic resources: Process structure and properties;

— Part 101 Integrated application resources: Draughting;

— Part 104 Integrated application resources: Finite element analysis;

— Part 105 Integrated application resources: Kinematics;

— Part 201 Application protocol: Explicit draughting;

— Part 202 Application protocol: Associative draughting;

— Part 203 Application protocol: Configuration controlled 3D designs of mechanical parts and assemblies;

— Part 207 Application protocol: Sheet metal die planning and design;

— Part 221 Application protocol: Process plant functional data and schematic representation;

— Part 225 Application protocol: Structural building elements using explicit shape representation.

The reader may obtain information on the other Parts of ISO 10303 from the ISO Central Secretariat.

Introduction

ISO 10303 is an International Standard for the computer-interpretable representation and exchange of product data. The objective is to provide a neutral mechanism capable of describing product data throughout the life cycle of a product independent from any particular system. The nature of this description makes it suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases and archiving.

This International Standard is organized as a series of parts, each published separately. The Parts of ISO 10303 fall into one of the following series: description methods, integrated resources, application protocols, abstract test suites, implementation methods, and conformance testing. The series are described in ISO 10303-1. This part of ISO 10303 is a member of the application protocol series. Application protocols provide the basis for developing implementations of ISO 10303 and abstract test suites for the conformance testing of AP implementations.

This part of ISO 10303 specifies an application protocol (AP) for the exchange of the spatial configuration information of process plants. This includes the shape and spatial arrangement characteristics of piping system components as well as the shape and spatial arrangement characteristics of other related plant systems (i.e., electrical, instrumentation and controls, and structural systems) that impact the design and layout of piping systems. This AP specifies additional requirements for the exchange of information required for the design and fabrication of a piping system. This includes information on the piping material, process stream fluid, and the piping system functional characteristics.

Clause 1 defines the scope of the application protocol and summarizes the functionality and data covered by the AP. An application activity model that is the basis for the definition of the scope is provided in Annex E. The information requirements of the application are specified in clause 4 using terminology appropriate to the application domain. A graphical representation of the information requirements, referred to as the application reference model, is given in annex F.

Resource constructs are interpreted to meet the information requirements. This interpretation produces the application interpreted model (AIM). This interpretation, given in 5.1, shows the correspondence between the information requirements and the AIM. The short listing of the AIM specifies the references to the integrated resources and is given in 5.2. The annotated listing of the AIM provides the commented EXPRESS listing including all the referenced integrated resources and is given in Annex A. A graphical representation of the AIM is given in annex G. Additional requirements for specific implementation methods are given in annex D.

Industrial automation systems and integration - Product data representation and exchange - Part 227: Application protocol: Plant spatial configuration

1 Scope

This Part of ISO 10303 specifies the use of the integrated resources necessary for the exchange of spatial configuration information of process plants. The spatial configuration information includes the shape and physical arrangement of the plant piping systems and other plant systems, i.e., structural, HVAC (heating, ventilation and air-conditioning), mechanical, electrical, and instrumentation and controls systems. The physical arrangement of the piping system is the realization of the logical design that specifies the functionality of the piping system. Components of the piping system include pipes, fittings, valves, equipment, and instruments.

This Part of ISO 10303 specifies the piping system information that support the design, fabrication, and maintenance of piping systems. This includes the identification and functional specification of the components of the piping system and the shape and spatial arrangement characteristics of components of piping systems and the other plant systems noted previously. This Part specifies information for the fabrication of piping plant systems only or components of these systems.

EXAMPLES

1 — The piping system design and layout may specify a pump component capable of maintaining a pressure and flow rate. The design will also specify the shape limitations or requirements, and the location of the pump in the system. However, it does not include sufficient detail for the fabrication of the pump because the pump will be purchased as a commodity from a supplier. This piping system design is within the scope of this Part.

2 — The design of the piping system must be coordinated with other physical systems such as HVAC and structural systems. The piping engineer must evaluate the piping design and layout with respect to the spatial characteristics of these other systems and the requirements for clearances between systems. The engineer does not need the complete specification of these systems, but only enough spatial information to design the piping system. The spatial characteristics of these systems are within the scope of this Part.

The design and layout of a piping system is exchanged between different agents over the life-cycle of a plant for many different reasons. These reasons include: the exchange of requirements from an Owner to an Architectural/Engineering (AE) firm; the exchange of process requirements for the piping system from a process engineer to a system design engineer; integration of designs created by different engineers; detection of physical interferences of piping system components with components of other plant systems; and exchange of construction specifications between AE and construction firms.

The shape of the piping system components are represented with solid models such as B-rep, CSG, and surfaced wireframe . Some shape characteristics are represented parametrically. The shape may be represented at various levels of abstraction of the shape, from an encompassing envelope to a detailed design description.

NOTE - The application activity model in annex F provides a graphical representation of the processes and information flows that are the basis for the definition of the scope of this part of ISO 10303.

The following are within the scope of this part of ISO 10303:

— The spatial arrangement of plant systems within the process plant;

— Explicit representation of the 3D shape of piping systems;

— Explicit representation of the 3D external shape of piping components and connected equipment of the piping system, that may include parametric, envelope, outline and detailed representations of external shape;

— The spatial arrangement of piping components and connected equipment that comprise the piping system;

— The logical configuration (connectivity and sequencing) of the piping system and the relationship of the logical configuration to the physical realization;

NOTE - The logical configuration is an overlap with the requirements specified in ISO 10303-221.

— Basic engineering data as needed for spatial layout and configuration of the piping system;

— References to functional requirements of the piping system, e.g., stream data, operational characteristics, etc.

— References to or designation of functional characteristics of piping components and connected equipment;

— The identification, shape, location, orientation, physical connectivity, and routings of components of plant systems, including HVAC, structural, mechanical, electrical equipment and raceways, and instrumentation and controls for non-piping systems, reserved areas, and space occupying architectural components;

— References to specifications, standards, guidelines, or regulations, for the piping systems, components, or connected equipment that may specify physical characteristics;

NOTE — Physical characteristics include items such as material and welding requirements.

— Status of plant spatial arrangement, piping components, and connected equipment;

— Connections and connection requirements for piping components and equipment;

— Definition of piping components sufficient for the acquisition of the components;

— Change request, approval, notification, verification, delta tracking, and documentation of plant spatial arrangement, piping components, and connected equipment.

The following are outside the scope of this part of ISO 10303:

— 2D schematic representations;

— The contents of specifications, standards, guidelines, or regulations;

— Aspects of non-piping plant systems, i.e., electrical, instrumentation and controls, structural, or mechanical systems, beyond spatial characteristics and shape;

— Fabrication of non-piping plant systems or components of these systems;

— Chemical composition of the streams carried by the piping system;

— Process design;

— Plant operating procedures;

— Commercial aspects (i.e., pricing, terms and conditions, payment schedules) of procurement procedures;

— Internal design of equipment.

2 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 10303-1 *Industrial automation systems and integration - Product data representation and exchange - Part 1: Overview and fundamental principles.*

ISO 10303-11 *Industrial automation systems and integration - Product data representation and exchange - Part 11: Description methods: The EXPRESS language reference manual.*

ISO 10303-21 *Industrial automation systems and integration - Product data representation and exchange - Part 21: Implementation methods: Clear text encoding of the exchange structure.*

ISO 10303-31 *Industrial automation systems and integration - Product data representation and exchange - Part 31: Conformance testing methodology and framework: General concepts.*

ISO 10303-41 *Industrial automation systems and integration - Product data representation and exchange - Part 41: Integrated generic resources: Fundamentals of product description and support.*

ISO 10303-42 *Industrial automation systems and integration - Product data representation and exchange - Part 42: Integrated generic resources: Geometric and topological representation.*

ISO 10303-43 *Industrial automation systems and integration - Product data representation and exchange - Part 43: Integrated generic resources: Representation structures.*

ISO 10303-44 *Industrial automation systems and integration - Product data representation and exchange - Part 44: Integrated generic resources: Product structure configuration.*

3 Definitions and abbreviations

3.1 Terms defined in ISO 10303-1

This part of ISO 10303 makes use of the following terms defined in ISO 10303-1:

— application;

— application activity model (AAM);

— application interpreted model (AIM);

— application protocol (AP);

— application reference model (ARM);

— conformance testing;

— implementation method;

— integrated resource;

— product;

— product data;

— unit of functionality (UoF).

3.2 Terms defined in ISO 10303-31

This part of ISO 10303 makes use of the following terms defined in ISO 10303-31:

— Abstract test suite (ATS);

— Conformance class;

— Protocol information and conformance statement (PICS).

3.3 Other definitions

For the purposes of this part of ISO 10303, the following definitions apply.

3.3.1 Basic engineering data

Parameters and descriptions which specify design characteristics and boundaries for the plant item (e.g., plate thickness, bore diameter, design codes, weights).

3.3.2 Functional characteristics

Nomenclature, codes, and named values that describe or specify the performance or behavior of a plant item (e.g., flow rates, operating pressure, maximum temperature).

3.3.3 Functional requirements

Nomenclature, codes, and named values that describe or specify the performance or behavior to be met by a plant item.

3.3.4 Spatial arrangement

The location, orientation, and relative position of the components of a plant system.

3.4 Abbreviations

For the purposes of this part of ISO 10303, the following abbreviations apply:

2D	Two-dimensional
3D	Three-dimensional
AEC	Architecture, Engineering, and Construction
B-rep	Boundary representation
CSG	Constructive Solid Geometry
HVAC	Heating, Ventilation, and Air Conditioning

4 Information Requirements

This clause specifies the information required for the exchange of plant spatial configuration information between application systems.

The information requirements are specified as a set of units of functionality, application objects, and application assertions. These assertions pertain to individual application objects and to relationships between application objects. The information requirements are defined using terminology of the subject area of this application protocol.

NOTES

1 - A graphical representation of the information requirements is given in annex F.

2 - The information requirements correspond to those of the activities identified as being in the scope of this application protocol in annex E.

3 - The mapping table specified in 5.1 shows how the information requirements are met using the integrated resources of this International Standard. The use of the integrated resources introduces additional requirements that are common to application protocols.

4.1 Units of Functionality

This subclause specifies the units of functionality (UoF) for the plant spatial configuration application protocol. This part of ISO 10303 specifies the following units of functionality:

- change UoF;
- connectivity UoF;
  - connection UoF;
  - connector UoF;
  - line_definition UoF;
- equipment UoF;
- material UoF;
- piping_component UoF;
- plant_item UoF;
- plant_system UoF;

— shape UoF;

— site UoF.

The units of functionality and a description of the functions that each UoF supports are given below. The application objects included in the UoFs are defined in 4.2.

4.1.1 change UoF

The change UoF represents the design change requests, approvals, etc., for modifications to plants, plant_items, plant_systems, and other components associated with the plant.

The following objects are contained in the change UoF:

— change;

— change_approval;

— change_request;

— change_verification;

— changed_item.

4.1.2 connectivity UoF

The connectivity UoF represents the physical and functional connectivity of plant items. The following UoFs are contained in the connectivity UoF:

— connector UoF;

— connection UoF;

— line_definition UoF.

The connector UoF and the connection UoF represent physical aspects of connectivity between plant items. The line_definition UoF represents functional connectivity among plant items.

Plant items have connectors. Connectors are attached to one other connector of a compatible type to form a connection. The sequence of connections establish the physical connectivity of items within plant systems.

4.1.2.1 connection UoF

The connection UoF represents the physical linkage or connectivity between plant items.

The following objects are used by the connection UoF:

— p_i_cnctn#associate;

— p_i_cnctn#contact;

— p_i_cnctn#p_i_locked_orientation;

— p_i_connection.

4.1.2.2 connector UoF

The connector UoF represents the physical feature(s) of plant items that are designed to connect or mate with other plant items. Connectors are attached to one other connector of a compatible type to form a connection. This UoF includes information about the type of plant_item connector.

The following objects are used by the connector UoF:

— p_i_cnctr#electric_type;

— p_i_cnctr#piping_type;

— p_i_cnctr#struct_type;

— p_i_piping_cnctr#flanged;

— p_i_piping_cnctr#socketweld;

— p_i_piping_cnctr#tap;

— p_i_piping_cnctr#threaded;

— pipe_cnctr_service_characteristic;

— plant_item_connector.

4.1.2.3 line_definition UoF

The line_definition UoF describes the specifications with which a flow stream in a piping system is characterized. It includes information about the segments in the line and the specification for these segments, such as design criteria, service conditions, and line identifier.

The following objects are used by the line_definition UoF:

— line_def_seg_insulation;

— line_def_seg_term_conn#line_branch;

— line_def_seg_term_conn#line_equip;

— line_def_seg_term_conn#line_line;

— line_def_seg_term_conn#line_pipe_comp;

— line_def_seg_term_connection;

— line_def_seg_termination;

— line_def_segment;

— line_definition;

— stream_definition_case.

4.1.3 equipment UoF

The equipment UoF represents plant items that perform a particular function within the plant process(es).

The following objects are used by the equipment UoF:

— equip_serv_operating_case;

— equip#compressor;

— equip#engine;

— equip#furnace;

— equip#gear_box;

— equip#heat_exchanger;

— equip#pressure_vessel;

— equip#pump;

— equip#silo;

— equip#tank;

— equip#turbine;

— equipment;

— equipment_service;

— equipment_trim_piping.

4.1.4 material UoF

The material UoF describes the information and options associated with the specification of the substance or substances of which a plant_item is composed.

NOTE - As used in this part, material does not refer to the products which flow within plant systems.

The following objects are used by the material UoF:

— material_requirement;

— matl_spec_selct#optional;

— matl_spec_selct#required;

— matl_spec_selct#subset_ref;

— matl_spec_selection.

4.1.5 piping_component UoF

The piping_component UoF represents the individual elements of the piping system within a plant. Piping components include pipe, fittings, valves, in-line equipment and other elements that regulate, control, or convey piping system fluids.

The following objects are used by the piping_component UoF:

— bent_pipe;

— coupling;

— elbow;

— fitting;

— flange;

— in-line_equipment;

— inline_instrmt;

— insert/bushing;

— lateral;

— olet;

— orifice_plate;

— pipe;

— pipe_bend;

— pipe_cap;

— piping_component;

— reducer/swage;

— spec_item;

— straight_pipe;

— tee;

— union;

— valve.

4.1.6 plant_item UoF

The plant_item UoF represents the items within a plant that occupy space and possess physical, measurable characteristics. This UoF specifies spatial and physical information about piping system components and equipment, but only spatial characteristics of components of other plant systems, such as HVAC and instrumentation.

The following objects are used by the plant_item UoF:

— cable_support;

— catalog_item;

— construction_material;

— electrical_component;

— instr_cable;

— instrument;

— insulation;

— p_i_assy#design_area;

— pi_co_commodity#in-spec;

— pi_co_procurement#commodity;

— pi_co_procurement#custom;

— pi_co_procurement#specialty;

— pi_spec_line_item;

— pi_support_function;

— piping_spec_line;

— piping_spool;

— piping_support_usage;

— plant_item;

— plant_item#support;

— plant_item_assembly;

— plant_item_location;

— plant_volume;

— plnt_hvac_sys_component;

— plnt_inst_ctl_sys_component;

— plnt_struct_sys_element;

— route.

4.1.7 plant_systems UoF

The plant_systems UoF represents identifiable collections of plant_items that perform specific functions within a plant. The plant items are functionally dependent on one another for the performance of the system and are interrelated through physical connections. The collection of plant systems as a whole enable the plant to operate.

The following objects are used by the plant_systems UoF:

— line-based_pipe_sys;

— line-less_pipe_sys;

— piping_system;

— plant_electrical_system;

— plant_hvac_system;

— plant_inst_cntl_system;

— plant_structural_system;

— plant_system.

4.1.8 shape UoF

The shape UoF specifies external representations of components, assemblies of components, and volumes of a plant. The component's external shape can be specified as an envelope of the space occupied by a component, as an outline of the component, or as a detailed definition of the component's shape. The shape can be represented using CSG, B-rep, wireframe and surface models or parametric descriptions.

The following objects are used by the shape UoF:

— expl_p_i_shp#detail;

— expl_p_i_shp#envelope;

— expl_p_i_shp#outline;

— geometric_element;

— geometry#b-rep;

— geometry#csg;

— geometry#wire_and_surface;

— geometry_reference;

— p_i_geom_origin;

— p_i_interference;

— p_i_interfering_shape_geometry;

— p_i_shape_geometry;

— plant_item_shape;

— plant_item_shape#explicit.

4.1.9 site UoF

The site UoF represents the macroscopic elements of a plant and the land on which the plant(s) is located. It includes information about the site location, infrastructure like roads and sewers, buildings and other structures located on the site, and processes performed on the site.

The following objects are used by the site UoF:

— plant;

— plant_process_capability;

— plant_unit;

— site;

— site_building;

— site_process_capability;

— site_road;

— sub_plant_rel.

4.2 Application objects

This subclause specifies the application objects for the plant spatial configuration information application protocol. Each application object is an atomic element that embodies a unique application concept and contains attributes specifying the data elements of the object. The definitions of the application objects and their data elements are given below.

4.2.1 AP227_exchange_item

An AP227_exchange_item is any spatial configuration information that is compliant with the requirements of AP 227. It may include piping system/component references to functional requirements/characteristics, specifications, standards, guidelines, and regulations.

The data associated with AP227_exchange_item are the following:

— id.

4.2.1.1 id

An id is a unique identifier associated with the exchange set.

4.2.2 AP227_exchange_set

An AP227_exchange_set is a set or grouping of AP227_exchange_items.

The data associated with AP227_exchange_set are the following:

— design_status;

— exchange_creation_date;

— id;

— source.

4.2.2.1 design_status

The design_status reflects the state of the design data being exchanged.

EXAMPLE 3 — The state of the design data can be preliminary, for information only, final, etc.

4.2.2.2 exchange_creation_date

The exchange_creation_date is the date on which the exchange set was created.

4.2.2.3 id

An id is a unique identifier associated with the exchange set.

4.2.2.4 source

A source identifies where the data in the exchange set originated.

> EXAMPLE 4 — The source of a line_id (line number) is the piping and instrument diagram (P&ID) or line designation list.

4.2.3 Bent_pipe

A Bent_pipe is an aggregation of pipe bends.

The data associated with Bent_pipe are the following:

— bent_pipe_min_wall_thickness;

— plant_item_id.

4.2.3.1 bent_pipe_min_wall_thickness

A bent_pipe_min_wall_thickness is the minimum allowed thickness of the pipe.

4.2.3.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.4 Cable_support

A Cable_support is a component that provides a pathway, support, and protection to cables.

The data associated with Cable_support are the following:

— cable_support_loading;

— cable_support_material;

— cable_support_type;

— plant_id;

— plant_item_id.

— plant_system_id.

4.2.4.1 cable_support_loading

A cable_support_loading is the load that the cable support is designed to carry.

4.2.4.2 cable_support_material

A cable_support_material is the substance(s) that the cable support is constructed of.

EXAMPLE 5 - The material for a rod hanger could be specified as A36 Carbon Steel.

4.2.4.3 cable_support_type

A cable_support_type is a description of the category of cable support.

4.2.4.4 plant_id

A plant_id is a unique identifier for the plant.

4.2.4.5 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.4.6 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.5 Catalog_item

A Catalog_item is a plant_item that is part of a list of plant_items contained in a specific document.

The data associated with Catalog_item are the following:

— catalog_item_id;

— catalog_vendor_name;

— catalog_vendor_model_number;

— catalog_vendor_ref_number;

— catalog_vendor_vers_number.

4.2.5.1 catalog_item_id

A catalog_item_id is a unique identifier for the catalog_item.

4.2.5.2 catalog_vendor_name

A catalog_vendor_name is the designation of the organization whose plant_items are described in the catalog.

4.2.5.3 catalog_vendor_model_number

A catalog_vendor_model_number is a designation assigned by the vendor to the plant_item.

4.2.5.4 catalog_vendor_ref_number

A catalog_vendor_ref_number is a designation used to refer to the plant_item in the catalog. It may be the same as the catalog_vendor_model_number.

4.2.5.5 catalog_vendor_vers_number

A catalog_vendor_vers_number is an indication of which representation of the plant_item is described in the catalog.

4.2.6 Change

A Change is the modification or requested modification of an item of a plant for some reason. A change may be a request to make a change, an approved change, or the verification of a change.

The data associated with Change are the following:

— business_unit;

— change_date;

— change_id;

— change_reason;

— project_no;

— requested_change;

— title.

4.2.6.1 business_unit

A business_unit is the organization/company responsible for the change.

4.2.6.2 change_date

A change_date is the time at which the change request was initiated.

4.2.6.3 change_id

A change_id is a unique identifier for the change.

4.2.6.4 change_reason

A change_reason describes the rationale for the change.

4.2.6.5 project_no

A project_no is a designation which identifies the project associated with the change.

4.2.6.6 requested_change

A requested_change is a description of the change.

4.2.6.7 title

A title is a short descriptive label for the change.

4.2.7 Change_approval

A Change_approval is the endorsement by an authority of the change.

The data associated with Change_approval are the following:

— approval_date;

— approver;

— change_id.

4.2.7.1 approval_date

An approval_date is the time that the approval authority signed the change as approved.

4.2.7.2 approver

An approver is the name of the individual who approved the change.

4.2.7.3 change_id

A change_id is a unique identifier for the change.

4.2.8 Change_request

A Change_request is a change that has been proposed but not approved or implemented.

The data associated with Change_request are the following:

— change_id;

— request_date;

— requestor;

— requestors_change_id.

4.2.8.1 change_id

A change_id is a unique identifier for the change.

4.2.8.2 request_date

A request_date is the time that the requestor made the change request.

4.2.8.3 requestor

A requestor is the person who initiated the change request.

4.2.8.4 requestors_change_id

A requestors_change_id is a unique identifier assigned by the requestor to the change request.

4.2.9 Change_verification

A Change_verification is a change that has been implemented.

The data associated with Change_verification are the following:

— change_id;

— verification_date;

— verified_by.

4.2.9.1 change_id

A change_id is a unique identifier for the change.

4.2.9.2 verification_date

A verification_date is the time when the change was determined to be implemented as specified in the change_request.

4.2.9.3 verified_by

A verified_by is the name of the person who performed the confirmation of the change implementation.

4.2.10 Changed_item

A Changed_item is a plant_item that has been modified or for which there is a request to modify.

The data associated with Changed_item are the following:

— changed_item_id;

— date;

— description;

— item_owner;

— revision;

— title.

4.2.10.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.10.2 date

A date indicates the time at which the item was or is to be changed.

4.2.10.3 description

A description provides a summary of the item being changed.

4.2.10.4 item_owner

An item_owner identifies the possessor of the item being changed.

4.2.10.5 revision

The revision indicates the current version of the change.

4.2.10.6 title

A title is a short descriptive label for the changed item.

4.2.11 Construction_material

A Construction_material is the substance(s) used as constituents in the construction of a plant_item.

The data associated with Construction_material are the following:

— material_id;

— material_name;

— material_specification.

4.2.11.1 material_id

A material_id is a unique identifier for the material.

4.2.11.2 material_name

A material_name is the designation given to the material.

4.2.11.3 material_specification

A material_specification is a document that specifies the requirements/characteristics of the substance(s) used in a plant_item in a complete, precise, verifiable manner.

4.2.12 Coupling

A Coupling is a fitting used to make a linear connection between two lengths of piping.

The data associated with Coupling are the following:

— coupling_depth-of-engagement;

— coupling_end-to-end_dim;

— coupling_o-diam;

— plant_item_id.

4.2.12.1 coupling_depth-of-engagement

A coupling_depth-of-engagement is the distance a pipe is inserted into the coupling.

4.2.12.2 coupling_end-to-end_dim

A coupling_end-to-end_dim is the external length of the coupling.

4.2.12.3 coupling_o-diam

A coupling_o-diam is the outside diameter of the coupling.

4.2.12.4 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.13 Elbow

An Elbow is a fitting used to change the direction of piping.

The data associated with Elbow are the following:

— elbow_centerline_radius;

— elbow_ctr-to-end_dim;

— elbow_o-diam;

— elbow_sweep_angle;

— plant_item_id.

4.2.13.1 elbow_centerline_radius

An elbow_centerline_radius is the distance from the center of the elbow (i.e., where the centerlines for the inlet and outlet ports intersect) to the intersection of the orthogonal projection of the inlet and outlet centerlines. The projection is taken from the inlet and outlet faces of the elbow and is in the plane formed by the centerlines.

4.2.13.2 elbow_ctr-to-end_dim

An elbow_ctr-to-end_dim is the distance from the center of the elbow (i.e., where the centerlines for the inlet and outlet ports intersect) to the inlet or outlet face of the elbow.

4.2.13.3 elbow_o-diam

An elbow_o-diam is the nominal outside diameter of the elbow.

4.2.13.4 elbow_sweep_angle

An elbow_sweep_angle is the angle swept in moving from the end of the elbow inlet to the end of elbow outlet while at the intersection of the orthogonal projection of the inlet and outlet centerlines at the inlet and outlet faces of the elbow.

4.2.13.5 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.14 Electrical_component

An Electrical_component is a individually identifiable and functional plant_item that is part of an electrical system.

EXAMPLE 6 — Electrical_components include cables, switches, relays, etc.

The data associated with Electrical_component are the following:

— plant_id;

— plant_item_id;

— plant_system_id.

4.2.14.1 plant_id

A plant_id is a unique identifier for the plant.

4.2.14.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.14.3 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.15 Equip#compressor

An Equip#compressor is a piece of equipment that increases the pressure of a gas or vapor by squeezing it.

The data associated with Equip#compressor are the following:

— compressor_type;

— equip_id;

— plant_item_id.

4.2.15.1 compressor_type

A compressor_type is a designation that classifies a compressor based on its operational characteristics.

EXAMPLE 7— Compressor types include centrifugal, reciprocating, and axial flow.

4.2.15.2 equip_id

An equip_id is a unique identifier for the equipment.

4.2.15.3 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.16 Equip#engine

An Equip#engine is a machine that converts the energy generated through the consumption of fuel into mechanical force and motion.

The data associated with Equip#engine are the following:

— engine_type;

— equip_id;

— plant_item_id.

4.2.16.1 engine_type

An engine_type is a designation that classifies an engine based on its operational characteristics.

EXAMPLE 8 — Engine types include gasoline, natural gas, and diesel.

4.2.16.2 equip_id

An equip_id is a unique identifier for the equipment.

4.2.16.3 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.17 Equip#furnace

An Equip#furnace is an enclosure in which heat is liberated and transferred directly or indirectly to a solid or fluid mass for the purpose of effecting a physical or chemical change.

The data associated with Equip#furnace are the following:

— equip_id;

— furnace_type;

— plant_item_id.

4.2.17.1 equip_id

An equip_id is a unique identifier for the equipment.

4.2.17.2 furnace_type

An furnace_type a designation that classifies a furnace based on its operational characteristics.

EXAMPLE 9 — Furnace types include blast, electric-arc, and submerged-arc.

4.2.17.3 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.18 Equip#gear_box

An Equip#gear_box is a system of gear wheels for changing the speed from that of the input shaft to that of the output shaft, or changing the direction of rotation, or changing the actual direction of a shaft with or without a speed change.

The data associated with Equip#gear_box are the following:

— equip_id;

— gear_box_type;

— plant_item_id.

4.2.18.1 equip_id

An equip_id is a unique identifier for the equipment.

4.2.18.2 gear_box_type

An gear_box_type is a designation that classifies a gear_box based on its operational characteristics.

4.2.18.3 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.19 Equip#heat_exchanger

An Equip#heat_exchanger is a device used to transfer heat from a fluid flowing on one side of a barrier (usually metal) to a fluid or fluids flowing on the other.

The data associated with Equip#heat_exchanger are the following:

— equip_id;

— heat_exchanger_type;

— plant_item_id.

4.2.19.1 equip_id

An equip_id is a unique identifier for the equipment.

4.2.19.2 heat_exchanger_type

An heat_exchanger_type is a designation that classifies a heat exchanger based on its operational characteristics.

EXAMPLE 10 — Heat exchanger types include shell and tube, plate-fin, and direct contact.

4.2.19.3 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.20 Equip#pressure_vessel

An Equip#pressure_vessel is a metal container, generally cylindrical or spheroid, capable of withstanding bursting pressures.

The data associated with Equip#pressure_vessel are the following:

— equip_id;

— plant_item_id;

— pressure_vssl_type.

4.2.20.1 equip_id

An equip_id is a unique identifier for the equipment.

4.2.20.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.20.3 pressure_vssl_type

An pressure_vssl_type is a designation that classifies a pressure vessel based on its operational characteristics.

4.2.21 Equip#pump

An Equip#pump is a machine that draws a fluid into itself through an entrance port and forces the fluid out through an exhaust port.

The data associated with Equip#pump are the following:

— equip_id;

— plant_item_id;

— pump_type.

4.2.21.1 equip_id

An equip_id is a unique identifier for the equipment.

4.2.21.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.21.3 pump_type

An pump_type is a designation that classifies a pump based on its operational characteristics.

4.2.22 Equip#silo

An Equip#silo is a large vertical, cylindrical structure made of reinforced concrete, steel, or timber, that is used for storage of various materials.

The data associated with Equip#silo are the following:

— equip_id;

— plant_item_id;

— silo_type.

4.2.22.1 equip_id

An equip_id is a unique identifier for the equipment.

4.2.22.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.22.3 silo_type

An silo_type is a designation that classifies a silo based on its operational characteristics.

4.2.23 Equip#tank

An Equip#tank is a large container for holding or storing fluids.

The data associated with Equip#tank are the following:

— equip_id;

— plant_item_id;

— tank_type.

4.2.23.1 equip_id

An equip_id is a unique identifier for the equipment.

4.2.23.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.23.3 tank_type

An tank_type is a designation that classifies a tank based on its operational characteristics.

4.2.24 Equip#turbine

An Equip#turbine is a machine in which the kinetic energy of a moving fluid (air, gas, water, or steam) is converted to mechanical power by the impulse or reaction of the fluid with a series of blades, buckets, or paddles arrayed about the circumference of a wheel or cylinder.

The data associated with Equip#turbine are the following:

— equip_id;

— plant_item_id;

— turbine_energy_source_fluid;

— turbine_type.

4.2.24.1 equip_id

An equip_id is a unique identifier for the equipment.

4.2.24.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.24.3 turbine_energy_source_fluid

An turbine_energy_source_fluid is the substance used to impart the kinetic energy to the turbine.

EXAMPLE 11 — Substances used drive a turbine include air, gas, water, and steam.

4.2.24.4 turbine_type

An turbine_type is a designation that classifies a turbine based on its operational characteristics.

4.2.25 Equipment

An Equipment is a plant_item that is treated as single and self-contained unit that provides a function. The data associated with Equipment are the following:

— changed_item_id;

— equip_delivery_date;

— equip_description;

— equip_id;

— equip_insulation_spec;

— equip_name;

— equip_performance_characteristics;

— equip_po_number;

— equip_requisition_number;

— equip_tag_number;

— equip_vendor_name;

— equip_weight;

— plant_item_id.

4.2.25.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.25.2 equip_delivery_date

A equip_delivery_date is the time(s) the purchase order was issued and when the equipment was or is scheduled to be delivered to the customer.

4.2.25.3 equip_description

An equip_description provides a narrative summary of the equipment.

4.2.25.4 equip_id

An equip_id is a unique identifier for the equipment.

4.2.25.5 equip_insulation_spec

An equip_insulation_spec refers to the specification which defines the insulation requirements for the equipment.

4.2.25.6 equip_name

An equip_name is a designation given to the equipment.

4.2.25.7 equip_performance_characteristics

An equip_performance_characteristics is the functional attributes of the equipment.

EXAMPLE 12 — Performance characteristics of a pump may be that it operates at 80% efficiency while pumping 1250 gpm.

4.2.25.8 equip_po_number

An equip_po_number is the purchase order number under which the equipment was purchased.

4.2.25.9 equip_requisition_number

An equip_requisition_number is a designation assigned to a written request for a piece of equipment.

4.2.25.10 equip_tag_number

An equip_tag_number is an identifier assigned to the equipment.

4.2.25.11 equip_vendor_name

An equip_vendor_name is the designation of the company/organization that is providing the equipment.

4.2.25.12 equip_weight

An equip_weight is the mass of the equipment.

4.2.25.13 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.26 Equipment_service

An Equipment_service is the capability of a piece of Equipment to handle a set of one or more stream definition cases.

The data associated with Equipment_service are the following:

— equip_id;

— equip_service_design_pressure;

— equip_service_design_temperature;

— equip_service_id;

— plant_item_id.

4.2.26.1 equip_id

An equip_id is a unique identifier for the equipment.

4.2.26.2 equip_service_design_pressure

An equip_service_design_pressure is the design pressure of the equipment.

4.2.26.3 equip_service_design_temperature

An equip_service_design_temperature is the design temperature of the equipment.

4.2.26.4 equip_service_id

An equip_service_id is a unique identifier for the equipment_service.

4.2.26.5 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.27 Equipment_serv_operating_case

An Equipment_serv_operating_case is the normal, upset, shutdown, etc. condition under which the equipment operating characteristics are being defined.

The data associated with Equipment_serv_operating_case are the following:

— equip_id;

— equip_serv_op_case_name;

— equip_service_op_case_operating_pressure;

— equip_service_op_case_operating_temperature;

— equip_service_id;

— plant_item_id;

— stream_case_type;

— stream_def_id.

4.2.27.1 equip_id

An equip_id is a unique identifier for the equipment.

4.2.27.2 equip_op_case_name

An equip_op_case_name is the designation of the condition under which the equipment operating characteristics are being defined.

4.2.27.3 equip_serv_op_case_operating_pressure

An equip_serv_op_case_operating_pressure is the operating pressure of the equipment under a specific operating case.

4.2.27.4 equip_serv_op_case_operating_temperature

An equip_serv_op_case_operating_temperature is the operating temperature of the equipment under a specific operating case.

4.2.27.5 equip_service_id

An equip_service_id is a unique identifier for the equipment_service.

4.2.27.6 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.27.7 stream_case_type

A stream_case_type is the normal, upset, shutdown, etc. condition under which the fluid stream characteristics are being defined.

4.2.27.8 stream_def_id

A stream_def_id is a unique identifier for the stream_definition_case.

4.2.28 Equipment_trim_piping

An Equipment_trim_piping is piping connected to a piece of equipment that is designed and possibly provided or installed by the equipment manufacturer.

The data associated with Equipment_trim_piping are the following:

— equip_id;

— plant_item_id.

4.2.28.1 equip_id

An equip_id is a unique identifier for the equipment.

4.2.28.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.29 Expl_p_i_shp#detail

An Expl_p_i_shp#detail is the 3D spatial volume that corresponds to the complete surface representation of a plant_item.

The data associated with Expl_p_i_shp#detail are the following:

— p_i_shape_id;

— plant_item_id.

4.2.29.1 p_i_shape_id

A p_i_shape_id is a unique identifier for the plant_item shape.

4.2.29.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.30 Expl_p_i_shp#envelope

An Expl_p_i_shp#envelope is a 3D spatial volume that completely encloses or bounds a plant_item.

The data associated with Expl_p_i_shp#envelope are the following:

— p_i_shape_id;

— plant_item_id.

4.2.30.1 p_i_shape_id

A p_i_shape_id is a unique identifier for the plant_item shape.

4.2.30.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.31 Expl_p_i_shp#outline

An Expl_p_i_shp#outline is a 3D spatial volume that corresponds to the bounding surface features of a plant_item.

The data associated with Expl_p_i_shp#outline are the following:

— p_i_shape_id;

— plant_item_id.

4.2.31.1 p_i_shape_id

A p_i_shape_id is a unique identifier for the plant_item shape.

4.2.31.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.32 Fitting

A fitting is a piping component used to join or terminate sections of pipe or provide changes of direction or branching in a pipe system.

The data associated with Fitting are the following:

— fitting_nominal_size_n;

— fitting_type;

— plant_item_id.

4.2.32.1 fitting_nominal_size_n

A fitting_nominal_size_n is the collection of nominal outside diameters of the fitting connectors when a fitting has more than one nominal size. These values are used for the second, third, etc., nominal sizes for the fitting.

4.2.32.2 fitting_type

A fitting_type is a designation that classifies a fitting based on it's physical and performance characteristics.

EXAMPLE 13 — Types of fittings include flange, tee, and elbow.

4.2.32.3 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.33 Flange

A Flange is an annular collar designed to permit a bolted connection with a similar collar.

The data associated with Flange are the following:

— flange_bore_diam;

— flange_face_finish;

— flange_hub_diam;

— flange_hub_thru-length;

— flange_hub_weld-pt_diam;

— flange_o-diam;

— flange_raised_face_diam;

— flange_raised_face_height;

— flange_thickness;

— plant_item_id.

4.2.33.1 flange_bore_diam

A flange_bore_diam is the diameter of the hole through the center of the flange.

4.2.33.2 flange_face_finish

A flange_face_finish is a description of the flange face surface texture.

4.2.33.3 flange_hub_diam

A flange_hub_diam is the diameter of the flange hub at it's widest point. The hub is the portion of the flange that is connected to a pipe or a piece of equipment.

4.2.33.4 flange_hub_thru-length

A flange_hub_thru-length is the distance between the flange face and the hub face.

4.2.33.5 flange_hub_weld-pt_diam

A flange_hub_weld-pt_diam is the outside diameter of the hub at the hub face.

4.2.33.6 flange_o-diam

A flange_o-diam is the outside diameter of the flange.

4.2.33.7 flange_raised_face_diam

A flange_raised_face_diam is the diameter of the raised portion of the flange face.

4.2.33.8 flange_raised_face_height

A flange_raised_face_height is the height of the raised portion of the flange face above the periphery of the flange face.

4.2.33.9 flange_thickness

A flange_thickness is the width of the flange at its periphery.

4.2.33.10 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.34 Geometric_element

A Geometric_element is the type of geometric modelling technique used to represent the shape of a plant_item.

The data associated with Geometric_element are the following:

— geom_elem_id.

4.2.34.1 geom_elem_id

A geom_elem_id is a unique identifier for the type of geometric_element.

4.2.35 Geometry#b-rep

A Geometry#b-rep is a geometric model of a manifold solid. A manifold solid is a finite, arcwise connected volume bounded by one or more surfaces, each of which is a connected, oriented, finite, closed two-manifold. There is no restriction on the number of through holes, nor on the number of voids within the volume. The Boundary Representation (B-rep) of a manifold solid utilizes a graph of edges and vertices embedded in a connected, oriented, finite, closed two-manifold surface.

4.2.35.1 geom_elem_id

A geom_elem_id is a unique identifier for the type of geometric_element.

4.2.36 Geometry#csg

A Geometry#csg is a geometric model constructed using regularized boolean operations, such as intersection and union, to combine primitive solids such as cylinders, spheres, and boxes to form a shape.

The data associated with Geometry#csg are the following:

— geom_elem_id.

4.2.36.1 geom_elem_id

A geom_elem_id is a unique identifier for the type of geometric_element.

4.2.37 Geometry#wire_and_surface

A Geometry#wire_and_surface is a geometric model consisting of a collection of curves or surfaces. A collection of curves is a wireframe representation. A wireframe representation of a geometric model contains information about the intersections of the surfaces forming the boundary but does not contain information about the surfaces themselves. A collection of surfaces need not form the complete boundary of a solid.

4.2.37.1 geom_elem_id

A geom_elem_id is a unique identifier for the type of geometric_element.

4.2.38 Geometry_reference

A Geometry_reference are geometric_elements in a model that are not part of a component shape, but provide additional information.

EXAMPLE 14 — A plant coordinate system origin point is an example of reference geometry.

4.2.39 In-line_equipment

An In-line_equipment is a piece of equipment that is inserted into the flow of a process stream to perform some function.

The data associated with Inline_equipment are the following:

— equip_id;

— plant_item_id.

4.2.39.1 equip_id

A equip_id is a unique identifier for the equipment.

4.2.39.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.40 Inline_instrmt

An Inline_instrmt is an instrument that is inserted into the flow of a process stream to measure some characteristic of the stream.

The data associated with Inline_instrmt are the following:

— control_loop_id;

— inst_id;

— plant_id;

— plant_item_id;

— plant_system_id.

4.2.40.1 control_loop_id

A control_loop_id is a unique identifier for the instrument loop.

4.2.40.2 inst_id

An inst_id is a unique identifier for the instrument.

4.2.40.3 plant_id

A plant_id is a unique identifier for the plant.

4.2.40.4 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.40.5 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.41 Insert/bushing

An Insert/bushing is a fitting with one external and one smaller internal end.

The data associated with Insert/bushing are the following:

— insert_or_bushing_end-to-end_dim;

— insert_or_bushing_engagement_depth;

— insert_or_bushing_i-diam;

— insert_or_bushing_o-diam;

— plant_item_id.

4.2.41.1 insert_or_bushing_end-to-end_dim

An insert_or_bushing_end-to-end_dim is the length of the insert or bushing from the end of one port to the end of the other port.

4.2.41.2 insert_or_bushing_engagement_depth

An insert_or_bushing_engagement_depth is the distance that the pipe is inserted into the insert or bushing.

4.2.41.3 insert_or_bushing_i-diam

An insert_or_bushing_i-diam is the inside diameter of the insert or bushing.

4.2.41.4 insert_or_bushing_o-diam

An insert_or_bushing_o-diam is the outside diameter of the insert or bushing.

4.2.41.5 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.42 Instr_cable

An Instr_cable is a wire associated with an instrument that transmits signals between the instrument sensor(s) and the instrument readouts such as gauges, meters, and alarms.

The data associated with Instr_cable are the following:

— plant_id;

— plant_item_id;

— plant_system_id.

4.2.42.1 plant_id

A plant_id is a unique identifier for the plant.

4.2.42.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.42.3 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.43 Instrument

An Instrument is a device that measures one or more performance characteristics of a system.

The data associated with Instrument are the following:

— control_loop_id;

— inst_id;

— instrument_actuation_type;

— instrument_control_pts;

— instrument_descriptor;

— instrument_signal_type;

— instrument_type;

— plant_id;

— plant_item_id;

— plant_system_id.

4.2.43.1 control_loop_id

A control_loop_id is a unique identifier for the instrument loop.

4.2.43.2 inst_id

An inst_id is a unique identifier for the instrument.

4.2.43.3 instrument_actuation_type

An instrument_actuation_type is a designation that classifies an instrument_actuation based on its operational characteristics.

EXAMPLE 15— Instrument actuators include pneumatic, solenoid, and motor.

4.2.43.4 instrument_control_pts

An instrument_control_pts define the set points for the controller.

EXAMPLE 16 — A level controller of a tank may have instrument control points for the upper and lower levels within the tank.

4.2.43.5 instrument_descriptor

An instrument_descriptor is a designation for the instrument.

4.2.43.6 instrument_signal_type

An instrument_signal_type is a designation that classifies an instrument signal based on its physical characteristics.

EXAMPLE 17 — Instrument signal types include electric and pneumatic.

4.2.43.7 instrument_type

An instrument_type is a designation that classifies an instrument based on its performance characteristics.

EXAMPLE 18 — Instrument types include flow control, level control, pressure, and temperature.

4.2.43.8 plant_id

A plant_id is a unique identifier for the plant.

4.2.43.9 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.43.10 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.44 Insulation

An Insulation is a material or assembly of materials used to provide resistance to heat flow.

The data associated with Insulation are the following:

— plant_item_id.

4.2.44.1 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.45 Lateral

A Lateral is a three-way fitting having two pipe ends opposite each other in a straight run and a branch outlet projecting from the run at an angle, usually 45 degrees.

The data associated with Lateral are the following:

— lateral_branch_angle;

— lateral_ctr-to-branch_dim;

— lateral_ctr-to-end_dim;

— lateral_o-diam_2;

— lateral_o-diam_1;

— plant_item_id.

4.2.45.1 lateral_branch_angle

A lateral_branch_angle is the angle that the branch projects from the straight run.

4.2.45.2 lateral_ctr-to-branch_dim

A lateral_ctr-to-branch_dim is the distance between the point where the branch and straight run centerlines intersect and the face of the branch.

4.2.45.3 lateral_ctr-to-end_dim

A lateral_ctr-to-end_dim is the distance between the point where the branch and straight run centerlines intersect and the outlet face of the straight run.

4.2.45.4 lateral_o-diam_2

A lateral_o-diam_2 is the outside diameter of the branch.

4.2.45.5 lateral_o-diam_1

A lateral_o-diam_1 is the outside diameter of the straight run.

4.2.45.6 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.46 Line-based_pipe_sys

A Line-based_pipe_sys is a piping system that has a line designation as defined in line_definition.

The data associated with Line-based_pipe_sys are the following:

— plant_id;

— plant_system_id.

4.2.46.1 plant_id

A plant_id is a unique identifier for the plant.

4.2.46.2 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.47 Line-less_pipe_sys

A Line-less_pipe_sys is a piping system that does not have a line designation as defined in line_definition.

The data associated with Line-less_pipe_sys are the following:

— plant_id;

— plant_system_id.

4.2.47.1 plant_id

A plant_id is a unique identifier for the plant.

4.2.47.2 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.48 Line_def_seg_insulation

A Line_def_seg_insulation is a logical connection between a line_segment and the insulation attached to the pipe associated with the line_segment.

The data associated with Line_def_seg_insulation are the following:

— changed_item_id;

— line_def_seg_id;

— line_id;

— line_insul_boundaries;

— line_insul_descriptor;

— line_insul_thickness;

— line_insul_type;

— plant_id;

— plant_system_id.

4.2.48.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.48.2 line_def_seg_id

A line_def_seg_id is a unique identifier for the line segment.

NOTE - Line definition segment identifiers do not correspond to any "real-world" identifiers assigned to lines by plant designers.

4.2.48.3 line_id

A line_id is a unique identifier for the line. It is usually an abbreviated part of the line_number.

EXAMPLE 19 — A line identifier for line A1A-PX-100-4"-150# might be PX-100.

4.2.48.4 line_insul_boundaries

A line_insul_boundaries is a description (possibly referring to a specification) which will define the boundaries for insulation on the line.

EXAMPLE 20 — The boundaries of a line insulation may be described as "personnel protection insulation shall extend to 12' above grade or walkway".

4.2.48.5 line_insul_descriptor

A line_insul_descriptor is a designation for the insulation.

4.2.48.6 line_insul_thickness

A line_insul_thickness is the thickness of the insulation.

4.2.48.7 line_insul_type

A line_insul_type is a designation that classifies insulation based on its operational characteristics.

EXAMPLE 21 — Line insulation may be provide for heat conservation or for personnel protection.

4.2.48.8 plant_id

A plant_id is a unique identifier for the plant.

4.2.48.9 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.49 Line_def_seg_term_conn#line_branch

A Line_def_seg_term_conn#line_branch is a connection between the logical termination of one line_segment and a point on another line_segment other than a termination.

The data associated with Line_def_seg_term_conn#line_branch are the following:

— line_branch_seq_number;

— line_def_seg_id;

— line_def_seg_term_id;

— line_id;

— line_seg_term_conn_id;

— plant_id;

— plant_system_id.

4.2.49.1 line_branch_seq_number

A line_branch_seq_number is a number that indicates the order that lines branch off of the main line.

4.2.49.2 line_def_seg_id

A line_def_seg_id is a unique identifier for the line segment.

4.2.49.3 line_def_seg_term_id

A line_def_seg_term_id is a unique identifier for the line segment termination.

4.2.49.4 line_id

A line_id is a unique identifier for the line. It is usually an abbreviated part of the line_number.

4.2.49.5 line_seg_term_conn_id

A line_seg_term_conn_id is a unique identifier for the line segment termination connection.

4.2.49.6 plant_id

A plant_id is a unique identifier for the plant.

4.2.49.7 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.50 Line_def_seg_term_conn#line_equip

A Line_def_seg_term_conn#line_equip is a connection between the logical termination of a line_segment and a piece of equipment.

The data associated with Line_def_seg_term_conn#line_equip are the following:

— equip_id;

— line_def_seg_id;

— line_def_seg_term_id;

— line_id;

— line_seg_term_conn_id;

— plant_id;

— plant_item_id;

— plant_system_id.

4.2.50.1 equip_id

A equip_id is a unique identifier for the equipment.

4.2.50.2 line_def_seg_id

A line_def_seg_id is a unique identifier for the line segment.

4.2.50.3 line_def_seg_term_id

A line_def_seg_term_id is a unique identifier for the line segment termination.

4.2.50.4 line_id

A line_id is a unique identifier for the line. It is usually an abbreviated part of the line_number.

4.2.50.5 line_seg_term_conn_id

A line_seg_term_conn_id is a unique identifier for the line segment termination connection.

4.2.50.6 plant_id

A plant_id is a unique identifier for the plant.

4.2.50.7 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.50.8 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.51 Line_def_seg_term_conn#line_line

A Line_def_seg_term_conn#line_line is a connection between the logical terminations of two line_segments.

The data associated with Line_def_seg_term_conn#line_line are the following:

— line_def_seg_id;

— line_def_seg_term_id;

— line_id;

— line_seg_term_conn_id;

— plant_id;

— plant_system_id.

4.2.51.1 line_def_seg_id

A line_def_seg_id is a unique identifier for the line segment.

4.2.51.2 line_def_seg_term_id

A line_def_seg_term_id is a unique identifier for the line segment termination.

4.2.51.3 line_id

A line_id is a unique identifier for the line.

4.2.51.4 line_seg_term_conn_id

A line_seg_term_conn_id is a unique identifier for the line segment termination connection.

4.2.51.5 plant_id

A plant_id is a unique identifier for the plant.

4.2.51.6 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.52 Line_def_seg_term_conn#line_pipe_comp

A Line_def_seg_term_conn#line_pipe_comp is a connection between the logical termination of a line_segment and a piping component.

The data associated with Line_def_seg_term_conn#line_pipe_comp are the following:

— line_def_seg_id;

— line_def_seg_term_id;

— line_id;

— line_seg_term_conn_id;

— plant_id;

— plant_item_id;

— plant_system_id.

4.2.52.1 line_def_seg_id

A line_def_seg_id is a unique identifier for the line segment.

4.2.52.2 line_def_seg_term_id

A line_def_seg_term_id is a unique identifier for the line segment termination.

4.2.52.3 line_id

A line_id is a unique identifier for the line. It is usually an abbreviated part of the line_number.

4.2.52.4 line_seg_term_conn_id

A line_seg_term_conn_id is a unique identifier for the line segment termination connection.

4.2.52.5 plant_id

A plant_id is a unique identifier for the plant.

4.2.52.6 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.52.7 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.53 Line_def_seg_term_connection

A Line_def_seg_term_connection is a logical linkage between a line_segment and another logical component of the piping system.

The data associated with Line_def_seg_term_connection are the following:

— changed_item_id;

— line_connection_type;

— line_def_seg_id;

— line_def_seg_term_id;

— line_id;

— line_seg_term_conn_id;

— plant_id;

— plant_system_id.

4.2.53.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.53.2 line_connection_type

A line_connection_type is a designation which classifies the line connection based on the kinds of things which are connected.

4.2.53.3 line_def_seg_id

A line_def_seg_id is a unique identifier for the line segment.

4.2.53.4 line_def_seg_term_id

A line_def_seg_term_id is a unique identifier for the line segment termination.

4.2.53.5 line_id

A line_id is a unique identifier for the line. It is usually an abbreviated part of the line_number.

4.2.53.6 line_seg_term_conn_id

A line_seg_term_conn_id is a unique identifier for the line segment termination connection.

4.2.53.7 plant_id

A plant_id is a unique identifier for the plant.

4.2.53.8 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.54 Line_def_seg_termination

A Line_def_seg_termination is one of two logical end-points of a line_segment.

> NOTE - Lines are composed of individual line segments. Line segments are connected through line segment terminations.

The data associated with Line_def_seg_termination are the following:

— changed_item_id;

— line_def_seg_id;

— line_def_seg_term_id;

— line_end_type;

— line_id;

— plant_id;

— plant_system_id.

4.2.54.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.54.2 line_def_seg_id

A line_def_seg_id is a unique identifier for the line segment.

4.2.54.3 line_def_seg_term_id

A line_def_seg_term_id is a unique identifier for the line segment termination.

4.2.54.4 line_end_type

A line_end_type is a designation that classifies a line end based on a description of the physical nature of the line end.

4.2.54.5 line_id

A line_id is a unique identifier for the line. It is usually an abbreviated part of the line_number.

4.2.54.6 plant_id

A plant_id is a unique identifier for the plant.

4.2.54.7 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.55 Line_def_segment

A Line_def_segment is an element of a line_definition.

The data associated with Line_def_segment are the following:

— changed_item_id;

— line_contents;

— line_def_seg_id;

— line_design_pressure;

— line_design_temperature;

— line_heat_tracing_type;

— line_id;

— line_operating_pressure;

— line_operating_temperature;

— line_paint_ref;

— line_size;

— plant_id;

— plant_system_id.

4.2.55.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.55.2 line_contents

A line_contents describes the fluid that flows through the piping associated with the line.

4.2.55.3 line_def_seg_id

A line_def_seg_id is a unique identifier for the line segment.

4.2.55.4 line_design_pressure

A line_design_pressure indicates the design pressure of the piping associated with the line.

4.2.55.5 line_design_temperature

A line_design_temperature indicates the design temperature of the piping associated with the line.

4.2.55.6 line_heat_tracing_type

A line_heat_tracing_type is a designation that classifies a line heat tracing based on operational characteristics.

EXAMPLE 22 — Kinds of line heat tracing include steam tracing and electrical.

4.2.55.7 line_id

A line_id is a unique identifier for the line. It is usually an abbreviated part of the line_number.

4.2.55.8 line_operating_pressure

A line_operating_pressure is the normal operating pressure of the piping associated with the line.

4.2.55.9 line_operating_temperature

A line_operating_temperature is the normal operating temperature of the piping associated with the line.

4.2.55.10 line_paint_ref

A line_paint_ref is a reference to the paint specification that details the painting requirements of the piping associated with the line.

4.2.55.11 line_size

A line_size is the diameter of the piping associated with the line.

4.2.55.12 plant_id

A plant_id is a unique identifier for the plant.

4.2.55.13 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.56 Line_definition

A Line-definition is a uniquely identifiable fluid flow stream in a piping system that is characterized by a common spec. It is a logical component of the overall flow scheme of a piping system. It is composed of a collection of interconnected line_segments.

The data associated with Line_definition are the following:

— changed_item_id;

— line_des_criteria;

— line_end_location;

— line_id;

— line_number;

— line_P&I_ref;

— line_service_type;

— line_start_location;

— plant_id;

— plant_system_id.

4.2.56.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.56.2 line_des_criteria

A line_des_criteria is the design criteria for the line.

> EXAMPLE 23 — The design criteria for a line may include information such as design pressure and temperature. It may also include a reference to a specification.

4.2.56.3 line_end_location

A line_end_location is the relative distance in the 'X, Y, Z' directions of the position for the downstream end of the line, from a specified point in the plant. The line_end_location position may also be defined by the downstream equipment or line the line is connected to.

4.2.56.4 line_id

A line_id is a unique identifier for the line. It is usually an abbreviated part of the line_number.

4.2.56.5 line_number

A line_number is a number assigned to the line and can be used to uniquely refer to a stream.

> EXAMPLE 24 — A1A-PX-100-4"-150#,is a coded number which identifies the line and the main design criteria - spec = A1A, process = PX, number = 100, size = 4", and rating = 150#.

4.2.56.6 line_P&I_ref

A line_P&I_ref is a reference to the P&I(s) that depict the line.

4.2.56.7 line_service_type

A line_service_type is a designation that classifies a line service based on the physical conditions to which the line will be subjected.

> EXAMPLE 25 — Line service types include high-pressure steam and cooling water.

4.2.56.8 line_start_location

A line_start_location is the relative distance in the 'X, Y, Z' directions of the position of the start (upstream end) of the line, from a specified point in the plant. The position of the line_start_location may also be defined by the upstream equipment or line the line is connected to.

4.2.56.9 plant_id

A plant_id is a unique identifier for the plant.

4.2.56.10 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.57 Material_requirement

A Material_requirement is a specification of the substance(s) from which a component is or is to be made.

The data associated with Material_requirement are the following:

— changed_item_id;

— material_spec_id;

— matl_spec_description.

4.2.57.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.57.2 material_spec_id

A material_spec_id is a unique identifier for the specification that provides the material requirements.

NOTE - The material spec identifier is typically a coded value that is company-specific.

4.2.57.3 matl_spec_description

A matl_spec_description is a description of the material requirement(s).

4.2.58 Matl_spec_selct#optional

A Matl_spec_selct#optional is a material specification selection that defines characteristics that may be used to define or augment a material_requirement.

The data associated with Matl_spec_selct#optional are the following:

— material_spec_id;

— optional_id;

— selection_id.

4.2.58.1 material_spec_id

A material_spec_id is a unique identifier for the specification that provides the material requirements.

4.2.58.2 optional_id

An optional_id is a unique identifier for the optional material specification.

4.2.58.3 selection_id

A selection_id is a unique identifier for the candidate material specification.

4.2.59 Matl_spec_selct#required

A Matl_spec_selct#required is a material specification that defines the characteristics that shall be used to define or augment a material_requirement.

The data associated with Matl_spec_selct#required are the following:

— material_spec_id;

— required_id;

— selection_id.

4.2.59.1 material_spec_id

A material_spec_id is a unique identifier for the specification that provides the material requirements.

4.2.59.2 required_id

A required_id is a unique identifier for the required material specification.

4.2.59.3 selection_id

A selection_id is a unique identifier for the candidate material specification.

4.2.60 Matl_spec_selct#subset_ref

A Matl_spec_selct#subset_ref is the reference parameters required to identify the applicable subset of a material_requirement.

The data associated with Matl_spec_selct#subset_ref are the following:

— material_spec_id;

— selection_id;

— subset_id.

4.2.60.1 material_spec_id

A material_spec_id is a unique identifier for the specification that provides the material requirements.

4.2.60.2 selection_id

A selection_id is a unique identifier for the candidate material specification.

4.2.60.3 subset_id

A subset_id is a unique identifier for the specified subset portion of a material_requirement.

4.2.61 Matl_spec_selection

A Matl_spec_selections is the candidate material specifications for piping system design.

The data associated with Matl_spec_selection are the following:

— changed_item_id;

— material_spec_id;

— matl_spec_select_description;

— matl_spec_select_type;

— selection_id.

4.2.61.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.61.2 material_spec_id

A material_spec_id is a unique identifier for the specification that provides the material requirements.

4.2.61.3 matl_spec_select_description

A matl_spec_select_description is a description of the selected material specification.

4.2.61.4 matl_spec_select_type

A matl_spec_select_type is a designation that classifies a material spec selection based on selection criteria.

4.2.61.5 selection_id

A selection_id is a unique identifier for the candidate material specification.

4.2.62 Olet

An Olet is a fitting welded onto a hole (drilled or cut) in the side of a pipe or other fitting. Its primary use is for making small branch connections or connecting instrument lines to piping components.

The data associated with Olet are the following:

— olet_base_o-diam;

— olet_outlet_o-diam;

— olet_projection;

— olet_skirt_o-diam;

— plant_item_id.

4.2.62.1 olet_base_o-diam

An olet_base_o-diam is the outside diameter of the olet at it's base.

4.2.62.2 olet_outlet_o-diam

An olet_outlet_o-diam is the outside diameter of the olet at it's outlet face.

4.2.62.3 olet_projection

An olet_projection is the distance (length) from the outside diameter of a pipe (where the olet is welded to the pipe) to the outlet end of an olet (sockolet, weldolet, etc.), measured along the outlet centerline.

4.2.62.4 olet_skirt_o-diam

The sides of an olet are tapered (not vertical). An olet_skirt_o-diam is the maximum outside diameter of the olet (measured perpendicular to the outlet centerline).

4.2.62.5 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.63 Orifice_plate

An Orifice_plate is a disk with a hole that is placed in a pipeline to measure flow.

The data associated with Orifice_plate are the following:

— o_plate_bore_diam;

— o_plate_o-diam;

— o_plate_thickness;

— plant_item_id.

4.2.63.1 o_plate_bore_diam

An o_plate_bore_diam is the diameter of the hole in the orifice plate.

4.2.63.2 o_plate_o-diam

An o_plate_o-diam is the outside diameter of the orifice plate.

4.2.63.3 o_plate_thickness

An o_plate_thickness is the thickness of the orifice plate.

4.2.63.4 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.64 P_i_assy#design_area

A P_i_assy#design_area is an aggregation of plant_item design elements related to a specific project.

The data associated with P_i_assy#design_area are the following:

— p_i_assy_id;

— project_id;

— volume.

4.2.64.1 p_i_assy_id

A p_i_assy_id is a unique identifier for the plant_item_assembly.

4.2.64.2 project_id

A project_id is a identifier for the project the plant_item_assembly is associated with.

4.2.64.3 volume

A volume is a unique identifier for the location of the collection of plant_items/components that comprise the assembly.

4.2.65 P_i_cnctn#associate

A P_i_cnctn#associate is a connection between two associated plant_items.

The data associated with P_i_cnctn#associate are the following:

— from;

— p_i_cnctr_id;

— to.

4.2.65.1 from

A from is the plant_item_id of the plant_item that is upstream of the connection.

4.2.65.2 p_i_cnctr_id

A p_i_cnctr_id is a unique identifier for the plant_item_connector.

4.2.65.3 to

A to is the plant_item_id of the plant_item that is downstream of the connection.

4.2.66 P_i_cnctn#contact

A P_i_cnctn#contact is a connection between two plant_items that are in physical contact with each other.

The data associated with P_i_cnctn#contact are the following:

— from;

— p_i_cnctr_id;

— p_i_contact_condition;

— to.

4.2.66.1 from

A from is the plant_item_id of the plant_item that is upstream of the connection.

4.2.66.2 p_i_cnctr_id

A p_i_cnctr_id is a unique identifier for the plant_item_connector.

4.2.66.3 p_i_contact_condition

A p_i_contact_condition is a description of any special conditions or requirements related to the connection of the plant_items.

4.2.66.4 to

A to is the plant_item_id of the plant_item that is downstream of the connection.

4.2.67 P_i_cnctn#p_i_locked_orientation

A P_i_cnctn#p_i_locked_orientation is a connection between two plant_items where the connector(s) are required to be oriented in a specific manner.

The data associated with P_i_cnctn#p_i_locked_orientation are the following:

— from;

— p_i_cnctr_id;

— p_i_orient_condition;

— to.

4.2.67.1 from

A from is the plant_item_id of the plant_item that is upstream of the connection.

4.2.67.2 p_i_cnctr_id

A p_i_cnctr_id is a unique identifier for the plant_item_connector.

4.2.67.3 p_i_orient_condition

A p_i_orient_condition is the relative rotation of a plant_item connector's 'local axis', in relation to the shape of the plant_item.

4.2.67.4 to

A to is the plant_item_id of the plant_item that is downstream of the connection.

4.2.68 P_i_cnctr#electric_type

A P_i_cnctr#electric_type is a physical feature of an electrical plant_item that is designed to connect or mate with a connector on some other plant_item.

The data associated with P_i_cnctr#electric_type are the following:

— p_i_cnctr_id;

— plant_item_id.

4.2.68.1 p_i_cnctr_id

A p_i_cnctr_id is a unique identifier for the plant_item_connector.

4.2.68.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.69 P_i_cnctr#piping_type

A P_i_cnctr#piping_type is a physical feature of a piping plant_item that is designed to connect or mate with a connector on some other plant_item.

The data associated with P_i_cnctr#piping_type are the following:

— p_i_cnctr_id;

— pipe_cnctr_class;

— pipe_cnctr_end_prep;

— pipe_cnctr_end_type;

— pipe_cnctr_insulation_spec;

— pipe_cnctr_location;

— pipe_cnctr_material;

— pipe_cnctr_name;

— pipe_cnctr_orientation;

— pipe_cnctr_size;

— pipe_cnctr_type;

— plant_item_id.

4.2.69.1 p_i_cnctr_id

A p_i_cnctr_id is a unique identifier for the plant_item_connector.

4.2.69.2 pipe_cnctr_class

A pipe_cnctr_class is the pipe class of the pipe connector.

4.2.69.3 pipe_cnctr_end_prep

A pipe_cnctr_end_prep is the contour prepared on the end of a pipe, fitting, or nozzle for welding.

4.2.69.4 pipe_cnctr_end_type

A pipe_cnctr_end_type is a designation that classifies a pipe connector based on the physical characteristics of the end of the connector.

EXAMPLE 26 — The end of a pipe connector may be threaded, flange, or socketweld.

4.2.69.5 pipe_cnctr_insulation_spec

A pipe_cnctr_insulation_spec is the insulation specification for the piping connector.

4.2.69.6 pipe_cnctr_location

A pipe_cnctr_location is the relative distance in the 'X, Y, Z' directions of the pipe connector, from the 'X, Y, Z' axis of the pipe.

4.2.69.7 pipe_cnctr_material

A pipe_cnctr_material is the substance(s) the pipe connector is made of.

4.2.69.8 pipe_cnctr_name

A pipe_cnctr_name is the name of the piping connector.

4.2.69.9 pipe_cnctr_orientation

A pipe_cnctr_orientation is the relative rotation of a pipe connector's 'local axis', in relation to the 'X, Y, Z' axis of the pipe.

4.2.69.10 pipe_cnctr_size

A pipe_cnctr_size is the nominal diameter of the piping the connector is connected to.

4.2.69.11 pipe_cnctr_type

A pipe_cnctr_type is a designation that classifies the pipe connector based on the nature of the connection for which it is intended.

EXAMPLE 27 — Pipe connector types include weld neck flange, slip on flange, and threaded coupling.

4.2.69.12 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.70 P_i_cnctr#struct_type

A P_i_cnctr#struct_type is a physical feature of a structural plant_item that is designed to connect or mate with a connector on some other plant_item.

The data associated with P_i_cnctr#struct_type are the following:

— p_i_cnctr_id;

— plant_item_id.

4.2.70.1 p_i_cnctr_id

A p_i_cnctr_id is a unique identifier for the plant_item_connector.

4.2.70.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.71 P_i_connection

A P_i_connection is a physical linkage between a plant_item connector and a connector associated with another plant_item. The joining conditions may be specified for the connection.

The data associated with P_i_connection are the following:

— changed_item_id;

— from;

— p_i_cnctr_id;

— p_i_cnctn_material;

— to.

4.2.71.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.71.2 from

A from is the plant_item_id of the plant_item that is upstream of the connection.

4.2.71.3 p_i_cnctr_id

A p_i_cnctr_id is a unique identifier for the plant_item_connector.

4.2.71.4 p_i_cnctn_material

A p_i_cnctn_material is the substance(s) used at the connection of two plant connectors.

4.2.71.5 to

A to is the plant_item_id of the plant_item that is downstream of the connection.

4.2.72 P_i_geom_origin

A P_i_geom_origin is the geometric origin of the plant_item.

4.2.73 P_i_interference

A P_i_interference is a situation where two or more plant_items have defined spatial volumes that completely or partially overlap.

The data associated with P_i_interference are the following:

— interference_id;

— plant_item_id.

4.2.73.1 interference_id

A interference_id is a unique identifier for the interference between plant_items.

4.2.73.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.74 P_i_interfering_shape_geometry

A P_i_interfering_shape_geometry is the shape of the spatial volume defined by the intersection of two or more plant_items.

The data associated with P_i_interfering_shape_geometry are the following:

— geom_elem_id;

— interference_id;

— p_i_shape_id;

— plant_item_id.

4.2.74.1 geom_elem_id

A geom_elem_id is a unique identifier for the type of geometric_element.

4.2.74.2 interference_id

A interference_id is a unique identifier for the interference between plant_items.

4.2.74.3 p_i_shape_id

A p_i_shape_id is a unique identifier for the plant_item shape.

4.2.74.4 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.75 P_i_location#building

A P_i_location#building is the position of the plant_item relative to the building.

The data associated with P_i_location#building are the following:

— bldg_number;

— p_i_location_id;

— plant_item_id;

— site_id.

4.2.75.1 bldg_number

A bldg_number is a unique number used to identify the building.

4.2.75.2 p_i_location_id

A p_i_location_id is a unique identifier for the plant_item_location.

4.2.75.3 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.75.4 site_id

A site_id is a unique identifier for the site.

4.2.76 P_i_location#plant

A P_i_location#plant is the position of the plant_item relative to the plant.

The data associated with P_i_location#plant are the following:

— p_i_loc_plant_coordinates;

— p_i_location_id;

— plant_id;

— plant_item_id.

4.2.76.1 p_i_loc_plant_coordinates

A p_i_loc_plant_coordinates is the 'X, Y, Z' values assigned to the plant_item's 'origin' (central locating point), within the plant.

4.2.76.2 p_i_location_id

A p_i_location_id is a unique identifier for the plant_item_location.

4.2.76.3 plant_id

A plant_id is a unique identifier for the plant.

4.2.76.4 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.77 P_i_location#site

A P_i_location#site is the position of the plant_item relative to the site.

The data associated with P_i_location#site are the following:

— p_i_location_id;

— plant_item_id;

— site_id.

4.2.77.1 p_i_location_id

A p_i_location_id is a unique identifier for the plant_item_location.

4.2.77.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.77.3 site_id

A site_id is a unique identifier for the site.

4.2.78 P_i_piping_cnctr#flanged

A P_i_piping_cnctr#flanged is a physical feature of a piping plant_item that is designed to connect or mate with a flanged connector on some other plant_item.

The data associated with P_i_piping_cnctr#flanged are the following:

— p_i_cnctr_id;

— piping_cnctr_flange_thickness;

— piping_cnctr_flange_o-diam;

— plant_item_id.

4.2.78.1 p_i_cnctr_id

A p_i_cnctr_id is a unique identifier for the plant_item_connector.

4.2.78.2 piping_cnctr_flange_thickness

A piping_cnctr_flange_thickness is the thickness of the flange.

4.2.78.3 piping_cnctr_flange_o-diam

A piping_cnctr_flange_o-diam is the outside diameter of the flange.

4.2.78.4 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.79 P_i_piping_cnctr#socketweld

A P_i_piping_cnctr#socketweld is a physical feature of a valve or fitting that allows partial insertion of a pipe in order to connect or mate with the pipe. The connection is completed by fillet welding the pipe to the valve or fitting.

The data associated with P_i_piping_cnctr#socketweld are the following:

— p_i_cnctr_id;

— piping_cnctr_socketweld_o-diam;

— piping_cnctr_socketweld_depth;

— plant_item_id.

4.2.79.1 p_i_cnctr_id

A p_i_cnctr_id is a unique identifier for the plant_item_connector.

4.2.79.2 piping_cnctr_socketweld_o-diam

A piping_cnctr_socketweld_o-diam is the outside diameter of the socketweld portion of the connector.

4.2.79.3 piping_cnctr_socketweld_depth

A piping_cnctr_socketweld_depth is the insertion distance of the pipe into the socket.

4.2.79.4 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.80 P_i_piping_cnctr#tap

A P_i_piping_cnctr#tap is a connector on a piping plant_item that is not an explicit feature of the piping plant_item design, but is created during the installation of the plant_item.

The data associated with P_i_piping_cnctr#tap are the following:

— p_i_cnctr_id;

— plant_item_id.

4.2.80.1 p_i_cnctr_id

A p_i_cnctr_id is a unique identifier for the plant_item_connector.

4.2.80.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.81 P_i_piping_cnctr#threaded

A P_i_piping_cnctr#threaded is a physical feature of a piping plant_item that is designed to connect or mate with a threaded connector on some other plant_item.

The data associated with P_i_piping_cnctr#threaded are the following:

— p_i_cnctr_id;

— piping_cnctr_thread_o-diam;

— piping_cnctr_thread_engagement_depth;

— plant_item_id

4.2.81.1 p_i_cnctr_id

A p_i_cnctr_id is a unique identifier for the plant_item_connector.

4.2.81.2 piping_cnctr_thread_o-diam

A piping_cnctr_thread_o-diam is the nominal outside diameter of the piping the connector is connected to.

4.2.81.3 piping_cnctr_thread_engagement_depth

A piping_cnctr_thread_engagement_depth is the insertion distance of the pipe into the connector.

4.2.81.4 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.82 P_i_shape_geometry

A P_i_shape_geometry is the set of geometric_elements that comprise the plant_item shape.

The data associated with P_i_shape_geometry are the following:

— geom_elem_id;

— p_i_shape_id;

— plant_item_id.

4.2.82.1 geom_elem_id

A geom_elem_id is a unique identifier for the type of geometric_element.

4.2.82.2 p_i_shape_id

A p_i_shape_id is a unique identifier for the plant_item shape.

4.2.82.3 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.83 Pi_co_commodity#in-spec

A Pi_co_commodity#in-spec is a commodity piping component that is within the specifications identified for a plant or piping system.

The data associated with Pi_co_commodity#in-spec are the following:

— plant_item_id.

4.2.83.1 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.84 Pi_co_procurement#commodity

A Pi_co_procurement#commodity is an item that is purchased 'off-the-shelf' and has standardized dimensional and engineering characteristics. Commodities are generally referred to by company-specific codes that define the key characteristics of the commodity.

The data associated with Pi_co_procurement#commodity are the following:

— pi_co_commodity_catalog_number;

— pi_co_commodity_item_size;

— pi_co_commodity_item_type;

— pi_co_commodity_spec_sht_ref;

— plant_item_id.

4.2.84.1 pi_co_commodity_catalog_number

A pi_co_commodity_catalog_number is the vendor catalog number that corresponds to the plant_item.

4.2.84.2 pi_co_commodity_item_size

A pi_co_commodity_item_size is the physical dimension(s), proportions, magnitude, or extent of the plant_item.

4.2.84.3 pi_co_commodity_item_type

A pi_co_commodity_item_type is a designation that classifies a commodity piping component based on characteristics of the item.

4.2.84.4 pi_co_commodity_spec_sht_ref

A pi_co_commodity_item_spec_sht_ref is a reference to the sheet in the specification that describes the plant_item requirements.

4.2.84.5 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.85 Pi_co_procurement#custom

A Pi_co_procurement#custom is a plant_item that is uniquely designed to meet the requirements of the specific application in the plant of which it is a part.

The data associated with Pi_co_procurement#custom are the following:

— p_i_procurement_design_spec;

— plant_item_id.

4.2.85.1 p_i_procurement_design_spec

A p_i_procurement_design_spec is the specification issued to procure the plant_item.

4.2.85.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.86 Pi_co_procurement#specialty

A Pi_co_procurement#specialty is a plant_item that is commonly available, but whose dimensional and engineering characteristics are not standardized.

The data associated with Plant_item#standard are the following:

— plant_item_id.

4.2.86.1 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.87 Pi_spec_line_item

A Pi_spec_line_item is a portion of a piping specification related to a single piping component.

The data associated with Pi_spec_line_item are the following:

— pi_spec_line_item_name;

— pi_spec_line_item_val_or_range;

— piping_spec_id;

— piping_spec_line_id;

— piping_spec_line_value_id.

4.2.87.1 pi_spec_line_item_name

A pi_spec_line_item_name is the designation given to the piping specification line item.

4.2.87.2 pi_spec_line_item_val_or_range

A pi_spec_line_item_val_or_range is the acceptable value or range of values for a particular piping specification line item.

4.2.87.3 piping_spec_id

A piping_spec_id is a unique identifier for the piping specification.

4.2.87.4 piping_spec_line_id

A piping_spec_line_id is a unique identifier for the line item.

4.2.87.5 piping_spec_line_value_id

A piping_spec_line_value_id is a unique identifier for line item value or range of values.

4.2.88 Pi_support_function

A Pi_support_function is a description of the purpose of the piping support.

The data associated with Pi_support_function are the following:

— piping;

— support;

— support_function_name.

4.2.88.1 piping

A piping is a unique identifier for the piping being supported.

4.2.88.2 support

A support is a unique identifier for the piping support.

4.2.88.3 support_function_name

A support_function_name is the designation given to the piping support.

4.2.89 Pipe

A Pipe is a hollow cylindrical conveyance, with a constant radius for the cross-sectional circle, for directing fluid or gas flow. It is not restricted to any length, diameter, or wall thickness. A pipe may be metallic or plastic and semi-rigid in nature.

NOTES

1 - A single physical piece of straight pipe with a connector at each end is a pipe component. The pipe itself is a collection of pipe components that corresponds to a logical line.

2 — In most cases, the pipe will conforming to the dimensional requirements for nominal pipe size as tabulated in standards such as ANSI B36.10 and ANSI B36.19. For special pipe having diameter not listed in the standards, the nominal diameter corresponds with the outside diameter.

The data associated with Pipe are the following:

— pipe_class;

— pipe_coating_ref;

— pipe_code_ref;

— pipe_design_condition;

— pipe_material_specification;

— pipe_o-diam;

— pipe_operating_condition;

— pipe_schedule_code;

— pipe_testing condition;

— pipe_weight_per_length;

— plant_item_id.

4.2.89.1 pipe_class

A pipe_class is a coded designation that describes the piping pressure class, material, and governing code.

EXAMPLE 28 — For example, EBD, where E is the pressure class (class 600), B is the material (carbon steel), and D is the governing code (ASME B31.1).

4.2.89.2 pipe_coating_ref

A pipe_coating_ref is a reference to where the coating requirements for the pipe are specified.

4.2.89.3 pipe_code_ref

A pipe_code_ref is a reference to a specific pipe code.

4.2.89.4 pipe_design_condition

A pipe_design_condition is a condition that the pipe is designed to handle.

4.2.89.5 pipe_material_specification

A pipe_material_specification is the substance(s) of which the pipe is made.

4.2.89.6 pipe_o-diam

A pipe_o-diam is the nominal outside diameter of the pipe.

4.2.89.7 pipe_operating_condition

A pipe_operating_condition is a condition that the pipe normally operates at.

4.2.89.8 pipe_schedule_code

A pipe_schedule_code is a description of specific design criteria such as permissible materials of construction, allowable working stresses, etc. which must be considered in the piping design.

4.2.89.9 pipe_testing_condition

A pipe_testing_condition is a condition that the pipe is tested at.

4.2.89.10 pipe_weight_per_length

A pipe_weight_per_length is the mass of the pipe per unit length.

4.2.89.11 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.90 Pipe_bend

A Pipe_bend is a section of pipe that changes the direction of fluid flow without the use of a fitting. Pipe_bend(s) may be aggregated into a bent_pipe.

The data associated with Pipe_bend are the following:

— pipe_bend_centerline_radius;

— pipe_bend_sweep_angle;

— plant_item_id.

4.2.90.1 pipe_bend_centerline_radius

A pipe_bend_centerline_radius is the distance from the point defined by the intersection of a normal projection of each face of the pipe bend along a plane defined by the pipe bend centerline to the centerline of the pipe bend.

4.2.90.2 pipe_bend_sweep_angle

A pipe_bend_sweep_angle is the angle swept in moving from the pipe bend inlet face to it's outlet face while at the point defined by the intersection of an orthogonal projection of each face of the pipe bend along a plane defined by the pipe bend centerline.

4.2.90.3 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.91 Pipe_cap

A Pipe_cap is a fitting used to close an end of a piping system. May also be a valve component.

The data associated with Pipe_cap are the following:

— pipe_cap_height;

— pipe_cap_o-diam;

— plant_item_id.

4.2.91.1 pipe_cap_height

A pipe_cap_height is the length of the cap.

4.2.91.2 pipe_cap_o-diam

A pipe_cap_o-diam is the outside diameter of the pipe cap.

4.2.91.3 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.92 Pipe_cnctr_service_characteristic

A Pipe_cnctr_service_characteristic is the condition(s) that the piping connector is expected to experience while in service.

The data associated with Pipe_cnctr_service_characteristic are the following:

— p_i_cnctr_id;

— pipe_cnctr_serv_char_type;

— pipe_cnctr_serv_design_pressure;

— pipe_cnctr_serv_design_temperature;

— pipe_cnctr_serv_operating_pressure;

— pipe_cnctr_serv_operating_temperature;

— plant_item_id.

4.2.92.1 p_i_cnctr_id

A p_i_cnctr_id is a unique identifier for the plant_item connector.

4.2.92.2 pipe_cnctr_serv_char_type

A pipe_cnctr_serv_char_type is a unique identifier for the type of connector service characteristic.

4.2.92.3 pipe_cnctr_serv_design_pressure

An pipe_cnctr_serv_design_pressure is the design pressure at the pipe connector.

4.2.92.4 pipe_cnctr_serv_design_temperature

An pipe_cnctr_serv_design_temperature is the design temperature at the pipe connector.

4.2.92.5 pipe_cnctr_serv_operating_pressure

An pipe_cnctr_serv_operating_pressure is the normal operating pressure at the pipe connector.

4.2.92.6 pipe_cnctr_serv_operating_temperature

An pipe_cnctr_serv_operating_temperature is the normal operating temperature at the pipe connector.

4.2.92.7 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.93 Piping_component

A Piping_component is an individually identifiable and functional item that is part of a piping system. It does not encompass equipment or pipe supports, but does include pipes, fitting, and valves.

The data associated with Piping_component are the following:

— pipe_comp_coating;

— pipe_comp_dimensional_std;

— pipe_comp_heat_trace_type;

— pipe_comp_lining;

— pipe_comp_material_specification;

— pipe_comp_material_category;

— pipe_comp_nominal_size;

— pipe_comp_ovality_allowance;

— pipe_comp_rating;

— pipe_comp_type;

— plant_item_id.

4.2.93.1 pipe_comp_coating

A pipe_comp_coating is a description of the substance(s) used to coat the external surface(s) of a piping component.

4.2.93.2 pipe_comp_dimensional_std

A pipe_comp_dimensional_std is the actual standard dimension of a piping_component of a given nominal size.

4.2.93.3 pipe_comp_heat_trace_type

A pipe_comp_heat_trace_type is the type of heat tracing used on the piping component.

4.2.93.4 pipe_comp_lining

A pipe_comp_lining is a description of the substance(s) used to line the internal surface(s) of a piping_component.

4.2.93.5 pipe_comp_material_specification

A pipe_comp_material_specification is a document that specifies, in a complete, precise, verifiable manner, the material requirements of the piping_component, and often, the procedures for determining whether these requirements have been satisfied.

4.2.93.6 pipe_comp_material_category

A pipe_comp_material_category is the category or type of material used in the piping component.

4.2.93.7 pipe_comp_nominal_size

A pipe_comp_nominal_size is the typical size of the piping_component.

4.2.93.8 pipe_comp_ovality_allowance

A pipe_comp_ovality_allowance is the acceptable deviation or tolerance allowed in the 'out-of-roundness' of the piping_component. This is, how much the piping_component can deviate from a perfect circle.

4.2.93.9 pipe_comp_rating

A pipe_comp_rating is the design pressure rating of the piping_component.

4.2.93.10 pipe_comp_type

A pipe_comp_type is a designation that classifies a piping component based on its function.

EXAMPLE 29 — Functions of piping components include flange, valve, coupling, reducer, and pipe.

4.2.93.11 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.94 Piping_spec_line

A Piping_spec_line is a portion of a piping specification related to a pipe line.

The data associated with Piping_spec_line are the following:

— piping_spec_category;

— piping_spec_id;

— piping_spec_line_id;

— piping_spec_name;

— piping_spec_source.

4.2.94.1 piping_spec_category

A piping_spec_category is the specific classification the piping specification.

4.2.94.2 piping_spec_id

A piping_spec_id is a unique identifier for the piping specification.

4.2.94.3 piping_spec_line_id

A piping_spec_line_id is a unique identifier for the line item.

4.2.94.4 piping_spec_name

A piping_spec_name is the designation given to the piping specification.

4.2.94.5 piping_spec_source

A piping_spec_source is the source of the requirement detailed in this portion of the piping specification.

NOTE - The source is commonly a national or international standard, such as ANSI B31.1.

4.2.95 Piping_spool

A Piping_spool is an aggregation of piping plant_items.

The data associated with Piping_spool are the following:

— p_i_assy_id;

— piping_spool_number;

— piping_spool_weight;

— spool;

— spool_comp.

4.2.95.1 p_i_assy_id

A p_i_assy_id is a unique identifier for the plant_item_assembly.

4.2.95.2 piping_spool_number

A piping_spool_number is a number assigned to the piping_spool.

4.2.95.3 piping_spool_weight

A piping_spool_weight is the measurable mass of the piping_spool.

4.2.95.4 spool

A spool is a unique identifier for the piping components that are part spool.

4.2.95.5 spool_comp

A spool_comp is a unique identifier for the collection of plant_items/components that comprise the assembly.

4.2.96 Piping_support_usage

A Piping_support_usage is the application of a plant item support to bear the weight of a pipe.

The data associated with Piping_support_usage are the following:

— piping;

— pi_support_detl_sht_ref;

— pi_support_displ_and_limits;

— pi_support_stiffness_mtx;

— pi_support_type;

— support.

4.2.96.1 piping

A piping is a unique identifier for the piping being supported.

4.2.96.2 pi_support_detl_sht_ref

A pi_support_detl_sht_ref is a reference to the sheet where the pipe support details are provided.

4.2.96.3 pi_support_displ_and_limits

A pi_support_displ_and_limits are degrees of freedom and rotation for the pipe support connection.

4.2.96.4 pi_support_stiffness_mtx

A pi_support_stiffness_mtx is a 3 x 4 matrix that describes the stiffness characteristics of the piping support.

4.2.96.5 pi_support_type

A pi_support_type is a designation that classifies a pipe support based on characteristics of the item.

4.2.96.6 support

A support is a unique identifier for the piping support.

4.2.97 Piping_system

A Piping_system is a system of interconnected components that conveys fluids throughout a plant by mechanical means and is subject to the same set or sets of design conditions.

The data associated with Piping_system are the following:

— changed_item_id;

— piping_sys_description;

— piping_sys_name;

— piping_system_code;

— piping_system_type;

— plant_id;

— plant_system_id.

4.2.97.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.97.2 piping_sys_description

A piping_sys_description is a description of the piping system.

4.2.97.3 piping_sys_name

A piping_sys_name is the designation given to the piping system.

4.2.97.4 piping_system_code

A piping_system_code is the code that describes the criteria to which the piping system was/is designed.

4.2.97.5 piping_system_type

A piping_system_type is a designation of whether a piping system is line-based or line-less.

4.2.97.6 plant_id

A plant_id is a unique identifier for the plant.

4.2.97.7 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.98 Plant

A Plant is a portion of a facility (or the entire facility) required to operate to produce product(s).

The data associated with Plant are the following:

— changed_item_id;

— plant_id;

— plant_name;

— plant_project_number;

— plant_operator;

— plant_owner;

— plant_site_location;

— plant_site_orientation;

— site_id.

4.2.98.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.98.2 plant_id

A plant_id is a unique identifier for the plant.

4.2.98.3 plant_name

A plant_name is the designation given to the plant.

4.2.98.4 plant_project_number

A plant_project_number is a number that designates the project that the plant is being built/modified under.

4.2.98.5 plant_operator

A plant_operator is the name of the organization responsible for the operation of the plant.

4.2.98.6 plant_owner

A plant_owner is the name of the organization that owns the plant.

4.2.98.7 plant_site_location

A plant_site_location is the geographic position of the plant site.

4.2.98.8 plant_site_orientation

A plant_site_orientation is the geographic orientation of the plant site.

4.2.98.9 site_id

A site_id is a unique identifier for the site.

4.2.99 Plant_electrical_system

A Plant_electrical_system is a system of wiring, switches, relays, and other equipment associated with receiving and distributing electricity.

The data associated with Plant_electrical_system are the following:

— changed_item_id;

— plant_id;

— plant_system_id;

— plt_elec_sys_name.

4.2.99.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.99.2 plant_id

A plant_id is a unique identifier for the plant.

4.2.99.3 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.99.4 plt_elec_sys_name

A plt_elec_sys_name is the name given to a plant electrical system.

4.2.100 Plant_hvac_system

A Plant_hvac_system (Heating, Ventilation, and Air Conditioning) conditions and controls the temperature, moisture content, cleanliness, air quality, and air circulation as required in a facility.

The data associated with Plant_hvac_system are the following:

— changed_item_id;

— hvac_sys_id;

— plant_id;

— plant_system_id;

— plt_hvac_sys_type.

4.2.100.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.100.2 hvac_sys_id

A hvac_sys_id is a unique identifier for the HVAC system.

4.2.100.3 plant_id

A plant_id is a unique identifier for the plant.

4.2.100.4 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.100.5 plt_hvac_sys_type

A plt_hvac_sys_type is a designation that classifies a plant hvac system based on the kind of service that it provides.

4.2.101 Plant_inst_cntl_system

A Plant_inst_cntl_system is a system of wiring, switches, controls, and other equipment associated with measuring the performance characteristics of plant systems.

The data associated with Plant_inst_cntl_system are the following:

— changed_item_id;

— plant_id;

— plant_system_id;

— plt_inst_cntl_sys_name.

4.2.101.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.101.2 plant_id

A plant_id is a unique identifier for the plant.

4.2.101.3 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.101.4 plt_inst_cntl_sys_name

A plt_inst_cntl_sys_name is the name given to the instrument control system.

4.2.102 Plant_item

A Plant_item is an item or piece of equipment that may be used as a component of the plant.

The data associated with Plant_item are the following:

— changed_item_id;

— plant_item_id;

— plant_item_type;

— plant_item_weight;

— procurement_type;

— route_id.

4.2.102.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.102.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.102.3 plant_item_type

A plant_item_type is a designation that classifies a plant item based on its function.

4.2.102.4 plant_item_weight

A plant_item_weight is a measure of the mass of a plant_item.

4.2.102.5 procurement_type

A procurement_type is a designation of whether the plant_item is procured as a commodity, custom, or standard item.

4.2.102.6 route_id

A route_id is a unique identifier for the route.

4.2.103 Plant_item#support

A Plant_item#support is a defined structural element provides support to a plant_item.

The data associated with Plant_item#support are the following:

— plant_item_id.

4.2.103.1 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.104 Plant_item_assembly

A Plant_item_assembly is an aggregation of plant_items or an aggregation of components that form a plant_item when assembled.

The data associated with Plant_item_assembly are the following:

— element;

— group;

— p_i_assy_id.

4.2.104.1 element

An element is a unique identifier for the plant_item or component that is part of the assembly.

4.2.104.2 group

A group is a unique identifier for the collection of plant_items/components that comprise the assembly.

4.2.104.3 p_i_assy_id

A p_i_assy_id is a unique identifier for the plant_item_assembly.

4.2.105 Plant_item_connector

A Plant_item_connector is a physical feature of a plant_item that is designed to connect or mate with a connector on some other plant_item.

The data associated with Plant_item_connector are the following:

— changed_item_id;

— p_i_cnctr_connect_point;

— p_i_cnctr_flow_direction;

— p_i_cnctr_id;

— p_i_cnctr_location;

— p_i_cnctr_orientation;

— plant_item_id.

4.2.105.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.105.2 p_i_cnctr_connect_point

A p_i_cnctr_connect_point is where the connector mated to the plant_item is connected to.

4.2.105.3 p_i_cnctr_flow_direction

A p_i_cnctr_flow_direction is the direction of the fluid flow at that point in the plant_item.

4.2.105.4 p_i_cnctr_id

A p_i_cnctr_id is a unique identifier for the plant_item connector.

4.2.105.5 p_i_cnctr_location

A p_i_cnctr_location is the relative position of the plant item connector with respect to the plant item.

4.2.105.6 p_i_cnctr_orientation

A p_i_cnctr_orientation is the relative orientation of the plant item connector with respect to the plant item.

4.2.105.7 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.106 Plant_item_location

A Plant_item_location is the position of the plant item within a plant.

The data associated with Plant_item_location are the following:

— p_i_location_id;

— plant_item_id;

— p_i_location_orientation.

4.2.106.1 p_i_location_id

A p_i_location_id is a unique identifier for the plant_item_location.

4.2.106.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.106.3 p_i_location_orientation

A plant_item_orientation is the orientation of the plant item within the plant.

4.2.107 Plant_item_shape

A Plant_item_shape is the shape used to represent a plant_item in the model.

The data associated with Plant_item_shape are the following:

— catalog_item_id;

— changed_item_id;

— p_i_shape_id;

— plant_item_id;

— plant_item_shp_type.

4.2.107.1 catalog_item_id

A catalog_item_id is a unique identifier for the catalog_item.

4.2.107.2 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.107.3 p_i_shape_id

A p_i_shape_id is a unique identifier for the plant_item shape.

4.2.107.4 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.107.5 plant_item_shp_type

A plant_item_shp_type is the explicit representation of the plant_item shape.

4.2.108 Plant_item_shape#explicit

A Plant_item_shape#explicit defines the level of detail used to represent the 3D spatial volume occupied by a plant_item.

The data associated with Plant_item_shape#explicit are the following:

— expl_p_i_shape_type;

— p_i_shape_id;

— plant_item_id.

4.2.108.1 expl_p_i_shape_type

An expl_p_i_shape_type is a designation of the type of detail used to represent a plant_item, i.e., an envelope, outline, or detailed representation.

4.2.108.2 p_i_shape_id

A p_i_shape_id is a unique identifier for the plant_item shape.

4.2.108.3 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.109 Plant_process_capability

A Plant_process_capability is a functional behavior that can be executed by the plant.

The data associated with Plant_process_capability are the following:

— plant_id;

— plant_production_capacity;

— plant_production_type.

4.2.109.1 plant_id

A plant_id is a unique identifier for the plant.

4.2.109.2 plant_production_capacity

A plant_production_capacity is the rated output of the plant with respect to a process capability.

4.2.109.3 plant_production_type

A plant_production_type is a designation that classifies the plant based on the products its produces.

4.2.110 Plant_structural_system

A Plant_structural_system is a combination of plnt_struct_sys_elements of an assembly or building including connections.

The data associated with Plant_structural_system are the following:

— changed_item_id;

— plant_id;

— plant_system_id;

— plt_struct_sys_name.

4.2.110.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.110.2 plant_id

A plant_id is a unique identifier for the plant.

4.2.110.3 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.110.4 plt_struct_sys_name

A plt_struct_sys_name is the name designation to a system of plant structural elements.

4.2.111 Plant_system

A Plant_system is a combination of plant_items which perform a function required for the plant to operate to produce product(s).

The data associated with Plant_system are the following:

— changed_item_id;

— plant_id;

— plant_system_id;

— plant_system_type.

4.2.111.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.111.2 plant_id

A plant_id is a unique identifier for the plant.

4.2.111.3 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.111.4 plant_system_type

A plant_system_type is a designation that classifies a plant system based on the function it performs.

EXAMPLE 30 - Plant systems include piping systems, structural systems, and hvac systems.

4.2.112 Plant_unit

A Plant_unit is the designation (name and/or number) given to a plant.

The data associated with Plant_unit are the following:

— plant_id;

— plant_unit_number.

4.2.112.1 plant_id

A plant_id is a unique identifier for the plant.

4.2.112.2 plant_unit_number

A plant_unit_number is the unit number assigned to a plant.

4.2.113 Plant_volume

A Plant_volume is a specifically defined (and usually named/numbered) 3D volume located within a plant. It may be a reserved_area or zone_area.

The data associated with Plant_volume are the following:

— changed_item_id;

— plant_item_id.

4.2.113.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change. (May be as simple as a date-time stamp.)

4.2.113.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.114 Plnt_hvac_sys_component

A Plnt_hvac_sys_component is an individually identifiable item or combination of items that is part of a HVAC system. It includes ductwork and HVAC equipment (fans, compressors, etc.).

The data associated with Plnt_hvac_sys_component are the following:

— hvac_component_description;

— hvac_sys_id;

— plant_id;

— plant_item_id;

— plant_system_id.

4.2.114.1 hvac_component_description

A hvac_component_description is a description of the HVAC component.

4.2.114.2 hvac_sys_id

A hvac_sys_id is a unique identifier for the HVAC system.

4.2.114.3 plant_id

A plant_id is a unique identifier for the plant.

4.2.114.4 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.114.5 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.115 Plnt_inst_ctl_sys_component

A Plnt_inst_ctl_sys_component is an individually identifiable item or combination of items that is part of the plant instrumentation and control system(s) such as wiring, switches, and controls.

The data associated with Plnt_inst_ctl_sys_component are the following:

— plant_id;

— plant_item_id;

— plant_system_id.

4.2.115.1 plant_id

A plant_id is a unique identifier for the plant.

4.2.115.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.115.3 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.116 Plnt_struct_sys_element

A Plnt_struct_sys_element is an individually identifiable item or combination of items that is part of the plant structural system(s). It includes structural steel members, walls, foundations, supports for plant_items, etc., and is primarily responsible for bearing loads.

The data associated with Plnt_struct_sys_element are the following:

— plant_id;

— plant_item_id;

— plant_system_id;

— struct_elem_design_code;

— struct_elem_exact_section;

— struct_elem_type.

4.2.116.1 plant_id

A plant_id is a unique identifier for the plant.

4.2.116.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.116.3 plant_system_id

A plant_system_id is a unique identifier for the plant_system.

4.2.116.4 struct_elem_design_code

A struct_elem_design_code is the designation given to a plant structural element, based on standard structural shapes.

EXAMPLE 31 — For example, 'W' is the designation for wide flanges, 'L' for angles, 'C' for bar size channels, 'T' for tee shapes, etc.

4.2.116.5 struct_elem_exact_section

A struct_elem_exact_section is the detailed shape of a cross section of the structural element.

4.2.116.6 struct_elem_type

A struct_elem_type is a designation that classifies a structural element based on its functional characteristics.

4.2.117 Reducer/swage

A Reducer/swage is a fitting that functions as a coupling, but has a smaller pipe size on one end.

The data associated with Reducer/swage are the following:

— plant_item_id;

— reducer/swage_centerline_offset;

— reducer/swage_end-to-end_length;

— reducer/swage_large_o-diam;

— reducer/swage_small_o-diam.

4.2.117.1 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.117.2 reducer/swage_centerline_offset

A reducer/swage_centerline_offset is the distance the centerline for the large end is offset from the centerline for the small end. This distance will be zero unless the plant_item is an eccentric reducer.

4.2.117.3 reducer/swage_end-to-end_length

A reducer/swage_end-to-end_length is the distance between the reducer large and small end faces.

4.2.117.4 reducer/swage_large_o-diam

A reducer/swage_large_o-diam is the outside diameter of the large end of the reducer.

4.2.117.5 reducer/swage_small_o-diam

A reducer/swage_small_o-diam is the outside diameter of the small end of the reducer.

4.2.118 Route

A Route is the path followed in traversing from one location to another.

The data associated with Route are the following:

— route_id.

4.2.118.1 route_id

A route_id is a unique identifier for the route.

4.2.119 Site

A Site is real estate and structures of a plant that are capable of performing functions that produce a product.

The data associated with Site are the following:

— site_address;

— site_coordinate;

— site_country;

— site_elevation;

— site_environmental_ref;

— site_id;

— site_locality;

— site_location;

— site_name;

— site_operator;

— site_owner.

4.2.119.1 site_address

A site_address is the street address (including city, state, and zip code as appropriate) of the site.

4.2.119.2 site_coordinate

A site_coordinate is the longitude and latitude coordinates of the site.

4.2.119.3 site_country

A site_country is the country the site is located in.

4.2.119.4 site_elevation

A site_elevation is the distance that the site is located above sea level.

4.2.119.5 site_environmental_ref

A site_environmental_ref is a reference to the document that details environmental information relevant to the site.

4.2.119.6 site_id

A site_id is a unique identifier for the site.

4.2.119.7 site_locality

A site_locality is the municipality or region where the site is located or is to be located.

4.2.119.8 site_location

A site_location is the address of the site.

4.2.119.9 site_name

A site_name is the designation given to the site.

4.2.119.10 site_operator

A site_operator is the company/organization that operates the site.

4.2.119.11 site_owner

A site_owner is the company/organization that owns the site.

4.2.120 Site_building

A Site_building is a partially or totally enclosed structure on a site that protects and supports systems within it's boundaries.

The data associated with Site_building are the following:

— bldg_number;

— site_bldg_location;

— site_bldg_name;

— site_id.

4.2.120.1 bldg_number

A bldg_number is a unique number used to identify the building.

4.2.120.2 site_bldg_location

A site_bldg_location is where the building is located on the site.

> EXAMPLE 32 — For example, E5704.35', N5912.87' are coordinates. They can be used to locate a known point in the building (e.g., centerlines of column row 1A).

4.2.120.3 site_bldg_name

A site_bldg_name is the designation given to the building.

4.2.120.4 site_id

A site_id is a unique identifier for the site.

4.2.121 Site_feature

A Site_feature is the make-up, shape, proportions, form, or outward appearance of a road, railway, water tower, etc. on the site.

The data associated with Site_feature are the following:

— site_feature_position;

— site_feature_shape;

— site_feature_type.

— site_id;

4.2.121.1 site_feature_position

A site_feature_position is location and orientation of the feature relative to the site.

4.2.121.2 site_feature_shape

A site_feature_shape is a 3D spatial volume that completely encloses or bounds a feature.

4.2.121.3 site_feature_type

A site_feature_type is a designation that classifies site_feature based on its physical and functional characteristics.

EXAMPLE 33 - Types of site features include roads and railways.

4.2.121.4 site_feature_id

A site_feature_id is a unique identifier for the site feature.

4.2.122 Site_process_capability

A Site_process_capability is the process conducted or executed on the site.

The data associated with Site_process are the following:

— changed_item_id;

— site_id;

— site_production_capacity;

— site_production_type.

4.2.122.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.122.2 site_id

A site_id is a unique identifier for the site.

4.2.122.3 site_production_capacity

A site_production_capacity is the rated output of the plant(s) on the site.

4.2.122.4 site_production_type

A site_production_type is a classification which describes the type of process performed on the site.

4.2.123 Spec_item

A Spec_item is a piping_component that is specially designed for a plant system. The functionality of the item precludes classification as a commonly used component, e.g., fitting.

The data associated with Spec_item are the following:

— plant_item_id;

— spec_item_descriptor;

— spec_item_type.

4.2.123.1 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.123.2 spec_item_descriptor

A spec_item_descriptor is a description of the specification for the item.

4.2.123.3 spec_item_type

A spec_item_type is the type of the item specified.

4.2.124 Straight_pipe

A Straight_pipe is a section of pipe that does not change the direction of fluid flow.

The data associated with Straight_pipe are the following:

— pipe_end-to-end_length;

— plant_item_id.

4.2.124.1 pipe_end-to-end_length

A pipe_end-to-end_length is the length of the pipe.

4.2.124.2 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.125 Stream_definition_case

A Stream_definition_case is the characteristics of the fluid stream under defined circumstances.

The data associated with Stream_definition_case are the following:

— stream_case_type;

— stream_constituents;

— stream_def_id;

— stream_description;

— stream_flow_rate;

— stream_liquid_density;

— stream_pressure;

— stream_specific_gravity;

— stream_surface_tension;

— stream_temperature;

— stream_vapor_compressibility;

— stream_vapor_density;

— stream_vapor_fraction;

— stream_vapor_heat_ratio;

— stream_viscosity.

4.2.125.1 stream_case_type

A stream_case_type is the normal, upset, shutdown, etc. condition under which the fluid stream characteristics are being defined.

4.2.125.2 stream_constituents

A stream_constituents are the various component elements of the fluid stream.

4.2.125.3 stream_def_id

A stream_def_id is a unique identifier for the stream_definition_case.

4.2.125.4 stream_description

A stream_description is a description of the fluid stream.

4.2.125.5 stream_flow_rate

A stream_flow_rate is the rate at which the fluid stream moves through a defined plant_item.

4.2.125.6 stream_liquid_density

A stream_liquid_density is the amount of liquid per unit volume.

4.2.125.7 stream_pressure

A stream_pressure is the amount of fluid force applied over a unit area.

4.2.125.8 stream_specific_gravity

A stream_specific_gravity is the ratio of the mass of a liquid stream to the mass of an equal volume of distilled water at 4 degrees Celsius or of a gaseous stream to an equal volume of air or hydrogen under prescribed pressure and temperature conditions.

4.2.125.9 stream_surface_tension

A stream_surface_tension is a property of liquids arising from the molecular cohesive forces at or near the surface of a liquid.

4.2.125.10 stream_temperature

A stream_temperature is the temperature of the fluid stream.

4.2.125.11 stream_vapor_compressibility

A stream_vapor_compressibility is a measure of the factor by which a vapor stream can be compressed at a given pressure.

4.2.125.12 stream_vapor_density

A stream_vapor_density is the amount of vapor per unit volume.

4.2.125.13 stream_vapor_fraction

A stream_vapor_fraction is the percentage of the fluid stream that is comprised of vapor.

4.2.125.14 stream_vapor_heat_ratio

A stream_vapor_heat_ratio is the ratio of specific heat of a vapor at constant pressure versus specific heat of the vapor at constant volume.

4.2.125.15 stream_viscosity

A stream_viscosity is a measure of the resistance of a fluid stream to deformation when subjected to a shear stress.

4.2.126 Sub_plant_rel

A Sub_plant_rel is a portion of a plant.

The data associated with Sub_plant_rel are the following:

— changed_item_id;

— component;

— contains.

4.2.126.1 changed_item_id

A changed_item_id is a unique identifier assigned to a change and associated with the items involved in the change. This id is used in tracking the resolution of the change.

4.2.126.2 component

A component is the plant_id of the sub-plant that is contained in the plant.

4.2.126.3 contains

A contains is plant_id of the plant that contains the sub-plant.

4.2.127 Tee

A Tee is a branched outlet fitting used to permit straight through and 90 degree flow.

The data associated with Tee are the following:

— plant_item_id;

— tee_ctr-to-branch-end_dim;

— tee_ctr-to-end_dim;

— tee_o-diam_1;

— tee_o-diam_small_end.

4.2.127.1 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.127.2 tee_ctr-to-branch-end_dim

A tee_ctr_to_branch-end_dim is the distance from the intersection of the tee straight run centerline and branch run centerline to the branch run face.

4.2.127.3 tee_ctr-to-end_dim

A tee_ctr-to-end_dim is the distance from the intersection of the tee straight run centerline and branch run centerline to the straight run inlet or outlet face.

4.2.127.4 tee_o-diam_1

A tee_o-diam_1 is the outside diameter of the straight run inlet or outlet.

4.2.127.5 tee_o-diam_small_end

A tee_o-diam_small_end is the outside diameter of the branch run.

4.2.128 Union

A Union is a multi-piece fitting which allows the joining or separating of piping without rotating the piping. It consists of two internally threaded ends and a center piece that draws the two ends together when rotated.

The data associated with Union are the following:

— plant_item_id;

— union_end-to-end_dim;

— union_engagement_depth;

— union_major_o-diam;

— union_minor_o-diam.

4.2.128.1 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.128.2 union_end-to-end_dim

A union_end-to-end_dim is the distance between the ends of the union.

4.2.128.3 union_engagement_depth

A union_engagement_depth is the distance a pipe is inserted into the union.

4.2.128.4 union_major_o-diam

A union_major_o-diam is the outside diameter of the two internally threaded ends of the union.

4.2.128.5 union_minor_o-diam

A union_minor_o-diam is the outside diameter of the center piece of the union.

4.2.129 Valve

A Valve is a piping_component which isolates or controls fluid direction or flow rate.

The data associated with Valve are the following:

— plant_item_id;

— valve_actuator_type;

— valve_body_o-diam;

— valve_descriptor;

— valve_end-to-end_length;

— valve_handwheel_diam;

— valve_handwheel_open_height;

— valve_id;

— valve_oper_body_diam;

— valve_oper_handwheel_diam;

— valve_operation_mode;

— valve_stem_diam;

— valve_stem_height;

— valve_type.

4.2.129.1 plant_item_id

A plant_item_id is a unique identifier for the plant_item.

4.2.129.2 valve_actuator_type

A valve_actuator_type is a descriptive designation of device or mechanism used to open, position, or close a valve.

4.2.129.3 valve_body_o-diam

A valve_body_o-diam is the outside diameter of the principal pressure containing shell of the valve.

4.2.129.4 valve_descriptor

A valve_descriptor is a description of the valve.

4.2.129.5 valve_end-to-end_length

A valve_end-to-end_length is the distance from the end of one port to the end of the opposite port of the valve.

4.2.129.6 valve_handwheel_diam

A valve_handwheel_diam is the diameter of the valve handwheel.

4.2.129.7 valve_handwheel_open_height

A valve_handwheel_open_height is the distance between the valve handwheel and the valve centerline when it the valve is in it's fully open position.

4.2.129.8 valve_id

A valve_id is a unique identifier for the valve.

4.2.129.9 valve_oper_body_diam

A valve_oper_body_diam is the outside diameter of the valve actuator body.

4.2.129.10 valve_oper_handwheel_diam

A valve_oper_handwheel_diam is the diameter of the valve actuator handwheel.

4.2.129.11 valve_operation_mode

A valve_operation_mode is the valve mode of operation.

4.2.129.12 valve_stem_diam

A valve_stem_diam is the diameter of the valve stem. The valve stem connects the valve disk and the valve actuator.

4.2.129.13 valve_stem_height

A valve_stem_height is the distance from the valve centerline to the top of the valve stem when the valve is in it's fully open position.

4.2.129.14 valve_type

A valve_type is a designation that classifies a valve based on the design of it's internals.

EXAMPLE 34 - Types of valves include gate, globe, check, and relief.

4.3 Application assertions

This subclause specifies the application assertions for the Plant Spatial Configuration application protocol. Application assertions specify the relationships between application objects, the cardinality of the relationships, and the rules associated required for the integrity and validity of the application objects and UoFs. The application assertions and their definitions are given below.

6 Conformance Requirements

NOTE - This is the first proposal for this clause of AP 227. This definition of conformance classes requires additional analysis with usage scenarios.

Conformance to ISO 10303-227 includes satisfying the requirements stated in this Part, the requirements of the implementation method(s) supported, and the relevant requirements of the normative references. This part of ISO 10303 provides a number of options that may be supported by an implementation. These options are listed in Table 1 and are grouped into the following conformance classes:

Class 1 - Basic logical design of piping, process, HVAC, and mechanical systems - includes support of surfaced wireframe geometry. The purpose of this conformance class is to provide an interface with ISO 10303-221.

Class 2 - Detailed physical design of piping, process, HVAC, and mechanical systems - includes support of CSG only. The purpose of this conformance class is to support detailed spatial and physical design and interference checking between piping and process systems.

Class 3 - Detailed physical design of piping, process, HVAC, and mechanical systems - includes support of surfaced wireframe, B-rep, and CSG. The purpose of this conformance class is to support detailed spatial and physical design for piping and process systems, interference checking between piping and process systems, and multiple types of geometric representation for plant items.

Class 4 - Detailed physical design of piping, process, HVAC, and mechanical systems and spatial description of other plant systems - includes support of CSG only. The purpose of this conformance class is support detailed spatial and physical design of piping and process systems and interference checking between all plant systems and plant items.

Class 5 - Detailed physical design of piping, process, HVAC, and mechanical systems and spatial description of other plant systems - includes support of surfaced wireframe, B-rep, and CSG. The purpose of this conformance class is support detailed spatial and physical design of piping and process systems, interference checking between all plant systems and plant items, and multiple types of geometric representation for plant items.

	CC 1	CC 2	CC 3	CC 4	CC 5
p1 plant systems	X	X	X		
p2 plant systems				X	X
g1 geometry	X		X		X
g2 geometry			X		X
g3 geometry		X	X	X	X
c1 connectivity	X				
c2 connectivity		X	X	X	X
s1 stream		X	X	X	X

Table 6.1 - Conformance Classes for AP 227

Notes for Table 1:

plant_systems
- p1: piping, process, HVAC, and mechanical systems
- p2: all plant systems

geometry and topology
- g1: wireframe and surfaces
- g2: Brep
- g3: CSG

connectivity
- c1: connections
- c2: connections and connectors

stream
- s1: piping, process, HVAC, and mechanical systems

CC3 and CC5: implementations are required to read all three types of geometric representations.

Support for a particular conformance class requires support of all the options specified in this class.

Annex F
(informative)

Application activity model

The application activity model (AAM) is provided to aid in understanding the scope and information requirements defined in this application protocol. The model is presented as a set of definitions of the activities and the data, and a set of activity figures. The diagrams use IDEF0 function modelling. Each activity may be decomposed to provide more detail. If an activity has been decomposed, a separate diagram is included.

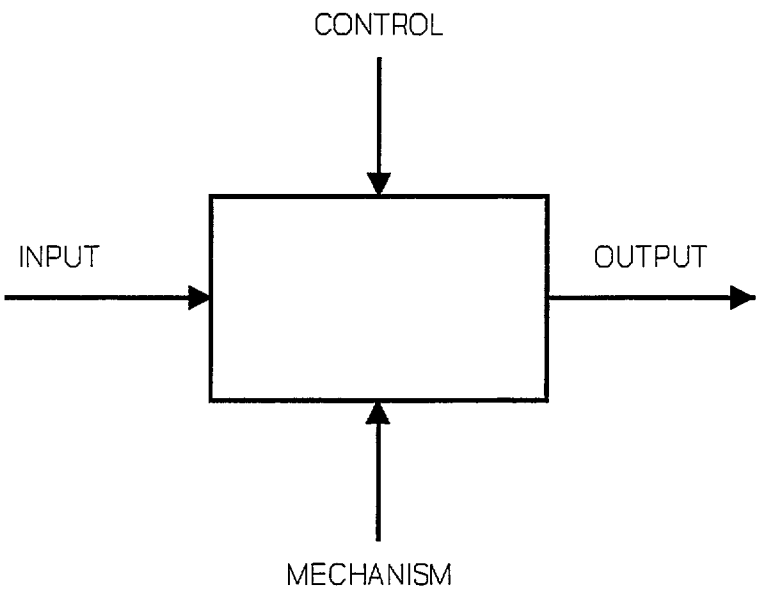

Figure F.1 - IDEF0 basic notation

As with any IDEF0 model, the application activity model is dependent on a particular viewpoint and purpose. The viewpoint of the application activity model is the user(s) of plant spatial configuration information, including architect, engineer, and builder.

F.1 Application activity model definitions

The following terms are used in the application activity model. Terms marked with an asterisk are outside the scope of this application protocol.

The definitions given in this annex do not supersede the definitions given in the main body of the text.

F.1.1 Analyze Final Plant Design (AAM A345): Examine all aspects of final design for compliance to performance criteria and generate any necessary changes required to meet these criteria.

F.1.2 Authorization Plan*: High level plan, justification, and forecast for design and construction of a plant. The authorization plan describes how funds, people, and resources are to be allocated for the plant project. It is a document used internally; it is sometimes called a "white paper".

F.1.3 As-built documents: Site plans, detailed equipment descriptions, electrical instrument diagrams, and P&Is that record the as-built conditions of a plant. They aid in meeting government documentation and safety requirements. Frequently, they are simply corrections or mods to existing design documents delivered to construction.

F.1.4 Bids*: Commercial proposal by vendor, supplier, etc., for provision of equipment, supplies, or services.

F.1.5 Build, Test, Inspect, and Ship Part (S9 A4): The process by which the vendor fabricates the item per the requestors requirement specifications and purchase agreement; the requestor inspects the item and performs quality and acceptance testing; and the item is transported to the requestor.

F.1.6 Calculate Heat/Mass Balance (A312) : Calculations performed based on Design Basis, Unit operations, Fuel and/or Materials in the process, along with associated chemical properties to optimize plant and operational cost.

F.1.7 Capital Appropriation*: Authorization of funding for capital project or expenditure.

F.1.8 Change Request: A request made by user of data (other than engineering user) for changes to original process plant design due to errors, omissions, and or other reasons (e.g., new requirements). A request is followed by review, analysis, and approval. Change requests are tracked in terms of cost, schedule (a kind of mini-project within project). Change requests may originate from construction or operations, for example.

Changes requests may be made against:
- — supplier list;
- — process;
- — plant;
- — procedure;
- — design basis.

F.1.9 Chem Props*: Important chemical data needed by the Process Engineer during design. This data will typically include, but is not limited to:

Boiling Point Critical Pressure Critical Temperature
Density Enthalpy Entropy
Flash Point Heat of Vaporization
Melting Point Molecular Weight
Specific Heat Thermal Conductivity
Viscosity

F.1.10 Codes: A widely recognized, accepted, and sometimes legally mandated set of rules that apply during the life-cycle of the plant. These rules govern life-cycle activities such design, fabrication, and operation and characteristics such as safety. Codes are a consensus documents/specification and are sometimes a subset of regulatory requirements. The ANSI 31.x series of codes are an example.

The design basis data specified will guide the code application, i.e., how the code is applied, e.g., 31.3 overpressuring is allowed for short periods of times to accommodate specific design basis scenarios.)

F.1.11 Commission Plant (AAM A56): Test the functionality of the completed plant prior to operation. Develop final operating and maintenance procedures. Obtain final regulatory approval to operate the plant.

F.1.12 Commissioned Plant*: A plant that has been proven to be operational through commissioning procedures.

F.1.13 Commissioning Procedures*: Step-by-step explanation of start-up actions required to commission plant.

F.1.14 Conceptual arrangement: The relative locations of required equipment, main piping runs, and any other critical project features that meet the criteria established in the design basis. It is then used as a basis for spatial configuration, which then leads to detail design (see System Layout/Design). It illustrates the relative positioning of items; contrast with spatial data. The conceptual arrangement is often presented in the form of a paper drawing.

F.1.15 Confirm Safety Compliance (AAM A344): Establish that the final design of the plant and facilities meets specified safety criteria.

F.1.16 Connector: A termination on an item that is or will be connected to a termination on another item. Connectors may participate in a connection with another item.

Examples of connections include:
— Equipment/piping (defined);
— Structure/equipment;
— Structure/piping.

For example, equipment/piping interface specifies physical location and characteristics of the boundary between mechanical equipment and connected piping system. The physical Location is the set of coordinate dimensions defining the placement of the interface in plant space. Characteristics include information such as interface component size, type, material, rating, configuration, and loading limitations.

Detailed explanation/definition of the connector is part of equipment characteristics.

F.1.17 Construct Plant (AAM A5): The process of building a physical plant, ready for use, using plans and building materials. The layout drawings and material requirements are used to establish the physical arrangement and to procure the materials required. A plan for erecting the plant is determined from material schedules, heavy equipment schedules, labor schedules, and environmental conditions (such as weather). Temporary erection material is procured as needed (such as scaffolding). Regulatory requirements and client requirements are used to plan and erect the plant, and for the final testing and certification for operation.

F.1.18 Construct Plant (L18 A3): (Palmer) The activities of constructing the plant as defined in plant design and the construction plan. These activities include verification that the design specification has been satisfied and that the resulting plant is acceptable to the commissioning team. (Wilson) The process of building a physical plant, ready for use, using plans and building materials. The layout drawings and material requirements are used to establish the physical arrangement and to procure the materials required. A plan for erecting the plant is determined from material schedules, heavy equipment schedules, labor schedules, and environmental conditions (such as weather). Temporary erection material is procured as needed (such as scaffolding). Regulatory requirements and client requirements are used to plan and erect the plant, and for the final testing and certification for operation.

F.1.19 Construction Services*: Constructor activities/ability to be used to construct plant.

F.1.20 Control and Approve Activities (AAM A11): Prepare plans, check conformance to plan, and arrange for corrective action.

F.1.21 Control Logic*: Prose/diagrammatic explanation of mechanisms/systems that monitor and control a process.

Initial . . .

F.1.22 Corporate Standards: Procedures, instructions, or specifications that may be used in the execution of a plant project and are standardized within an organization; they are not project specific, but may be used (and possibly customized) by a variety of projects. Corporate standards are developed over a long period of time as standard, recommended, or best practice.

Kinds of standards include:

— safety;
— design;
— maintenance.

F.1.23 Define Plant Operating Philosophy (AAM A331): Ascertain and confirm those plant operating characteristics and activities necessary to achieve facility owner's operational goals such as Methods of Production, Technology, Plant Safety, Plant Availability, etc. Includes selecting types and sequences of unit operations and processing steps so that the plant production objectives can be achieved. Specify alternate or abnormal operating conditions and procedures such as startup and shutdowns.

F.1.24 Define Procedures, Standards, and Guidelines (AAM A13): Define the engineering policies to be used and determine appropriate codes and standards that may apply.

F.1.25 Delivery Dates*: Scheduled date for delivery of procured items to meet or support construction.

F.1.26 Deploy Component (AAM A44): The process by which the part/service is delivered and the acquisition agreement is fulfilled.

F.1.27 Design Basis: A document provided by the plant owner or developed by the AEC contractor(s) which establishes or defines the information/data on which plant engineering is to be based. It consists of guidelines/requirements, corporate standards, codes, references to regulatory agreements, form of deliverables, plant/production capacity.

The design basis will specify:

- Type of plant;
- Plant product or output (type and capacity);
- Plant inputs (fuel, feedstock, etc.);
- Plant operating requirements;
- Plant process requirements;
- Site parameters (geographical, meteorological, soils, hydrological);
- Environmental requirements;
- Design Safety Philosophy;
- Plant license/permit requirements.

It also addresses performance objectives for the plant such as:

- Safety and health;
- Environmental;
- Investment and project economics;
- Schedule;
- Capacity;
- Product and raw material storage;
- Product and facility quality;
- Engineering quality;
- Project execution;
- Technology.

Performance objectives usually takes the form of a written document owned and maintained by the project team (consisting of members from the business, engineering, construction, and plant site).

NOTE - This definition is from an owners perspective.

F.1.28 Design Boiler (Boiler Design A1): Produce the functional specification and general engineering design for a boiler.

F.1.29 Design Piping (S3/L21): Establish the routing of piping from origination to terminus points, given a knowledge of spatial arrangements of plant components such as structural steel, production equipment, service equipment, and utility distribution networks.

F.1.30 Design Plant (AAM A3): The activity of extending a concept into detailed a plant definition suitable to support component purchase and plant construction.

F.1.31 Design Plant (L18 A2): Engineering activity necessary to develop conceptual facility data and expand concept to facilitate construction activities.

F.1.32 Design safety philosophy: A statement describing, in general terms, how the plant will be designed to address potential safety hazards such as earthquake, and fire, usually through judicious reference to applicable regulations codes, and standards. The primary objective of the design safety philosophy is to protect the people; it may result in safety system spec. The design safety philosophy is usually reflected in or encompassed by the owner requirements, corporate standards, or design basis.

F.1.33 Design Strategy: The "how-to" for the design. It encompasses building technology, mechanical technology, utility technology, automation technology, schedules, scope, standards and regulations, process definition, control philosophies, costs, benefits and timings, and project approach (AE, CM, internal).

F.1.34 Develop Technical Requirements (S9 A1): The process by which the engineering group determines all the technical information required to have an item fabricated by a vendor.

F.1.35 Dispose of Plant (AAM A64): Plan and complete the activities required to dispose of the plant.

F.1.36 Engineer/Design Equipment (AAM A323): Preliminary sizing of all major pieces of equipment required is made at this time with enough detail to obtain budget quotes. This should include refrigeration machines, purchase power substations, secondary substations, switch gear, compressors, boilers, etc., as well as the major process equipment specific to the facility.

F.1.37 Engineer/Design Plant Systems (AAM A322): At the conceptual level, this is a preliminary scoping of all major modifications and/or additions to the major plant distribution systems for steam, compressed air, electrical power, refrigeration, water, firewater, sewers (storm, process, sanitary), etc. Impact on distribution pipe lines and feeder systems quantity and size are also included. A consideration of system operation in terms of reliability, uptime, planned maintenance, and winter/summer operations are vital to proper planning.

F.1.38 Environmental Impact Assessment*: Evaluation of project/plant's affect on environment. A report is usually required by Environmental Regulatory Agency before construction can begin.

F.1.39 Environmental/permitting information*: Minimum environmental criteria and waste treatment, and maximum discharges allowed by governmental regulations and company policies. This information will contribute to the development of a detailed list of all facilities, streams, discharges, operations, et al., that will be regulated by all/any governmental agencies for which permits must be secured prior to initiating construction and operation.

F.1.40 Equipment: Plant items that can be treated as self-contained and uniquely functional, a "black box". Equipment is usually big and expensive.

Examples of equipment include: boilers, vessels.

Examples of items that are not considered equipment include: plant, pipe.

The following are kinds of equipment:
- — Capital;
- — Replacement.

F.1.41 Equipment characteristics: Physical or functional attributes of an item that have a name and measurable value. Equipment characteristics may be subdivided into physical and functional characteristics.

Physical equipment characteristics describe or specify the size, material, shape of the equipment. They are items of information that describe the shape, position, and orientation of equipment. For a pump, such information might include primitive elements (boxes, cylinders, etc.) to describe the shape, the position of suction and discharge nozzles and flange ratings of the nozzles.

Functional/performance characteristics describe or specify the process requirements for the equipment: what is it supposed to do and how much is it supposed to do it. They are items of information that describe: (1) the effect that equipment has on the process, or (2) the facility or service provided to the process by the equipment,and (3) other operational information. For a pump, such information might include flowrate, total developed head, efficiency, and a descriptive name or title, such as 1502-B Condensate Return Pump B.

Equipment Process Requirements are a subset of Equipment Functional Data that describe the contribution to the process desired from equipment. Such data is specified prior to the actual selection of specific equipment to fulfill the purpose.

F.1.42 Equipment List: A list of equipment in the process plant. List is comprised of, but not limited to, name, identifier (i.e. tag), location (i.e. building, elevation, area, column row, etc.), contract numbers (i.e. purchase, install, etc), spare requirements, service requirements (i.e. air, water, structural base, electrical power, control circuitry, etc.), drawing references (i.e. P&ID, plant arrangements, etc.) and if applicable, electrical load and type. The list may not include all equipment; it does not include miscellaneous equipment/devices (i.e. y-pattern strainers, inline flow meters, instruments, etc.) or valves.

F.1.43 Erect Plant (AAM A53): Utilizing plans, materials, services and labor, build the physical plant which conforms with the detailed design. This process begins with the site preparation; grading and

primary foundations poured, and temporary roads and rails created. Utility services are provided and temporary warehouses are built. Major equipment is moved, often in pieces, and installed on foundations with supporting steel. Site permanent buildings are built, as is pipe racks and other permanent steel. Pipe runs and pipe spools are put in place with valves and miscellaneous equipment and welded or joined. Ducting, electrical, instrumentation, etc. are installed.

F.1.44 Establish Design Basis (AAM A23): The activity of collecting a complete and consistent set of constraints, requirements, and guidelines for subsequent engineering activities. This activity results in the development of the design basis documents. See Design Basis.

F.1.45 Establish Design Basis (S3/L21 A1): The activity of design that focuses on the conceptual level for both the process design and the facility design of the project. See Produce Conceptual Process Design (AAM A31) and Produce Conceptual Facility Design (AAM A32).

F.1.46 Establish Initial Control Logic (AAM A314) : Document philosophical and operational requirements between instrumentation, equipment and process.

F.1.47 Establish Spatial Configuration (S3/L21 A2): The activity of determining the spatial relationships between all project components and systems that are significant or critical to the successful satisfaction of the project design basis. These include at least major equipment, major systems, reserved areas, and the plant site.

F.1.48 Evaluate Bids and Commit Purchase (AAM A43): The process by which bid packages are evaluated, a vendor is selected, and an agreement is entered into for the acquisition of the part.

F.1.49 Fabricate (S3/L21 A4): Using layout drawings and/or isometrics, develop piping spool drawings indicating cut lengths, bends, welds, and special treatments. Procure sufficient pipe, fittings and steel as needed to meet the fabrication delivery schedule. Cut and bend pipe per spool drawings. Cut steel as indicated for pipe supports (shoes, anchors, etc.). Assemble pipe pieces, fittings and support steel into spools using welding or other techniques. Inspect completed spools per inspection plan. Rework errors as necessary. Tag spools according to designation on layout drawings or isometrics and ship to construction site or staging area.

F.1.50 Finalize Layout/Arrangement/Spatial Design (AAM A342): Develop the spatial design of the plant to its final approved-for-construction state; the primary input is the finalized system design.

F.1.51 Finalize Purchase Agreements and Design (S9 A3): The process by which the combined technical and commercial requirements are agreed upon and approved by the purchasing group, the engineering group, and the vendor.

F.1.52 Finalize System Design (AAM A341): Develop the system design, expressed by flow and control information and equipment performance data, to its final state. The resulting design serves as a basis for detailed plant and facility design.

F.1.53 Guidelines/Requirements: Specifications, instructions, and mandates specified by management that shall be followed in plant project. They may be project specific. Guidelines are more generally applicable than requirements, which tend to be specific in terms of what must be done.

Originators and users of guidelines and requirements are:

— A&E;
— E&C;
— EPC;
— Owner;
— Constructor;
— CM;
— Contractor (basic practices).

These categories not mutually exclusive.

F.1.54 Incorporate Commercial Requirements (S9 A2): The process by which the purchasing group takes the technical requirements and adds all legal contractual issues and terms, shipping and handling information, and tax information.

F.1.55 Identify/Analyze Safety Requirements/Hazards (AAM A315) : Review Design Basis, Unit Operations, Heat/Mass Balances, Materials, Identified Equipment, Control Logic and Process Flow Diagram against federal,state and/or local regulations, codes and/or standards to determine compliance and produce an analysis of results.

F.1.56 Identify/Define Unit Operations (AAM 311): Incorporate Design Basis and Owner Requirements to define and document basis for conceptual process design. If the design activity is related to an existing facility, then existing operations are incorporated into the conceptual process design. This activity also results in estimated time and cost expenditures.

F.1.57 Identify Facility Performance Requirements and Establish Design Strategy (AAM A321): Facility Performance Requirements are a quantitative description of the quantity and quality of a product to be produced by the facility in a yearly time period. Usually stated as "units of product/unit time". Additional qualifications are made regarding the quality of the facility. Examples include: time between major shutdowns for continuous processes, percent uptime required, expected yield, etc.

Design strategy is a description of major steps required to complete enough design to obtain a budget estimate for business calculations as well as begin the identification of process unknowns which may or may not require piloting.

F.1.58 Identify/Size Equipment (AAM A313): Identify equipment requirements based on Design Basis and Unit Operations. Sizing of the equipment is based on the Heat/Mass Balance calculations and Unit Operations.

F.1.59 Inspection plan*: The description of anticipated activities necessary for surveillance of vendors, fabricators and assemblers to verify compliance to contractual specifications, codes and good practice. The plan usually lists the items to be inspected, the place at which the inspections are expected to occur,

anticipated frequency of inspection and type of activity to be undertaken at each inspection. The reporting procedure for the surveillance results is usually included in the developed inspection plan.

F.1.60 Inspection Results*: Reports that result from inspection and vendor surveillance activities.

F.1.61 Layout Plant (AAM A324): A general arrangement of the plant in plan view, showing all the major components of the distribution systems affected by the facility and the location of the facility within the plant. A general arrangement of all major equipment within the battery limits of the facility is also included.

F.1.62 Line Sched/list: A subset of information presented on the Process & Instrumentation Diagram (P&ID) (and possibly the Heat/Mass balance) that describes the characteristics of pipelines required for a given process. This information is used by the Piping Designer during the Detail Design. Analogous to equipment list.

F.1.63 Maintain Plant (AAM A63): Conduct and monitor the activities required to maintain the plant.

F.1.64 Maintain Suppliers List (AAM A41): The process by which a list of accepted/approved suppliers is kept up to date.

F.1.65 Manage Plant (AAM A61): Direct and administrate the operations, maintenance, and disposal of the plant.

F.1.66 Manage Project (AAM A1): Provide sufficient resources to execute the project and check that the execution is done in accordance with the plans and regulations.

F.1.67 Material Requirements: The specification of material(s), material options, and/or material parameters for a plant item. Includes references to applicable specifications and standards.

F.1.68 Money*: Funds available or committed for plant project.

F.1.69 Obtain Agreements with Regulatory Bodies (AAM A22): The activity of confirming that the intended design, construction, commissioning, operation, and decommissioning of the proposed project will comply with requirements of the regulatory body. This confirmation is recorded by formal documentation such as written agreements and safety compliance reports.

F.1.70 Obtain Construction Services: Use the construction plan as a requirements list for outside services needed and their schedule. Negotiate contracts and agreements with sub-contractors, equipment suppliers, and labor unions as needed for the erection of the plant. Adjust schedule of construction plan to allow for availability of sub-contractors, equipment and labor.

F.1.71 Operate, Maintain, and Dispose of Plant (AAM A6): The activities required to operate, maintain, and dispose of the plant safely, efficiently, and according to operating procedures and regulations.

F.1.72 Operate and Maintain Plant (L18 A4): The activities required to operate and maintain the plant safely, efficiently, and according to operating procedures and regulations.

F.1.73 Operate Plant (AAM A62): Conduct and monitor the activities required to operate the plant.

F.1.74 Operating Procedures*: Documentation necessary to run plant safely; it covers many different phases and aspects of plant operation.

F.1.75 Optimize for Environment (AAM A336): Evaluate the facility design against the applicable environmental regulations (Federal, State, and local) and modify where required. These regulations influence many of the activities in plant and process design such as operating procedures, plant and process control strategies, specification and design of piping, instrumentation, and equipment, as well as site selection. Broad regulatory interpretations often mean that conservative measures are incorporated in plant design.

F.1.76 Owner Reqmts: A initial statement of plant requirements provided by the owner. It is an aggregation of design requirements, specifications, standards, client general spec, etc. The owner requirement may be provided at any level of abstraction from very general to very specific. Leads to design_basis.

F.1.77 Piping and Instrumentation Diagram (P&ID): A schematic diagram which shows engineering details of the equipment, instruments, pipes, valves, and their connectivity and sequence.

The following are kinds of P&IDs which reflect the evolutionary cycle of design:

Preliminary: Conveys the flow of the fluids from equipment to equipment in the system. It shows the valves which are used to control the flow. The major fluid containing lines have been sized.

Approved for Design (AFD): Process definition firm, needs instrumentation.

Design: Instrumentation details are included. All lines and valves have been sized. All valving, vents and drains are included. Instrumentation and loops are indicated but final instrumentation may not have been selected.

Final: Complete P&ID; approved for release by engineering for construction; a sealed document. It is a last version of the design P&ID. It contains all changes which were incorporated during the physical design of the systems. It reflects the plant as it was, or will be, constructed.

F.1.78 Personnel*: A body of persons, usually employed in a factory, office, or organization.

F.1.79 Plan/Analyze Project Finances (AAM A21): The activity of anticipating and estimating the financial resource requirements for a project. This activity establishes the expected financial performance for the project and the project financial plan.

F.1.80 Plan Plant (L18 A1): Development of plant requirements and organization of activities necessary to deliver completed facility.

F.1.81 Plan Plant Spatial Location and Connection (Revamp Plant FEO2): Perform the engineering activities necessary to change the plant facility to meet the process change requirements.

F.1.82 Plan Plant Project (AAM A2): The activity that established a detailed technical plan and a financial plan that are consistent with the engineering, construction, and commissioning activities required to fulfill the project objectives.

F.1.83 Plan Spatial Location & Connection (Boiler Design A2): Produce the detailed engineering design for a boiler. This includes specifying the functional characteristics, location, orientation, and physical characteristics of connections and supporting fabrication information.

F.1.84 Plant: A facility that produces chemicals, pharmaceuticals, electrical power, petroleum, and similar products (i.e., one that produces "stuff" rather than "things").

F.1.85 Pre-commission Plant (AAM A55): Resolve any differences between the detailed design and the as-built plant. Changes occur primarily to the documentation of the plant. Perform all testing required by regulatory agencies and the client. Resolve any problems which were discovered during testing. Obtain regulatory permission to start-up the plant for functional testing.

F.1.86 Precommissioned Plant*: A plant that is completed plant ready for check out. Mechanical complete; transfer of ownership, operation remain.

F.1.87 Prepare Bid Packages and Solicit Bids (AAM A42): The process by which the technical and commercial requirements for a part are compiled and sent out for pricing by multiple vendors.

F.1.88 Process Flow Diagram (PFD)?: A diagram of the plant process flow scheme and related information. The PROCESS is defined as the chemical, physical or other schemes which are used to produce a resulting product. The FLOW is defined as the relationship of operations, reactions and other steps that are required to produce the product. It also may specify the stream connections, stream flow rates and compositions, and operating conditions.

The diagram usually contains simplified representation of basic instrumentation, operating conditions and material information necessary to provide a basic understanding of the process flow.

PFDs evolve through stages like P&IDs and other design documentation.

F.1.89 Procure Components (AAM A4): The process by which needed parts, equipment, or services are purchased or acquired.

F.1.90 Procured item*: Plant item that has been obtained from vendor or supplier for incorporation into facility.

States or status of procured items include:
- — In_fabrication;
- — Accepted;

— Shipped;
— Delivered_to_site.

F.1.91 Produce As-built Surveys (AAM A54): The completed plant is given a physical inspection to determine where the plant no longer conforms to the detailed design. The detail design drawings and other documents are updated to reflect these changes. Remove construction materials, temporary buildings, and equipment from the completed plant. Place surplus plant material in the spare parts warehouse or otherwise dispose of.

F.1.92 Produce Conceptual Facility Design (AAM A32): The activity of extending the conceptual process design into a preliminary plant spatial arrangement.

F.1.93 Produce Conceptual Process Design (AAM A31): The activity of defining the basic parameters of plant flow scheme. Parameters include relationship of operations necessary to transform feed stock into a product.

F.1.94 Produce Conceptual Safety Engineering Designs (AAM A325): Designs which specifically address how the major hazards associated with the new facility are to be dealt with to ensure the safety of all personnel working in the facility as well as the general site and surrounding neighborhood population. These hazards will have been identified during the preliminary screening reviews to identify chemical, fire and health hazards associated with the specific chemical and/or mechanical characteristics of the process.

F.1.95 Produce Construction Plans (AAM A51): Using site drawings, layout drawings, and other documents, determine the desired sequence to building the plant which will meet contract budget and schedule. Determine those services which will be needed from sub-contractors for the site preparation, erection, and testing of the plant. Develop detailed erection drawings and schedules for each section of the plant and for temporary structures.

F.1.96 Produce Final Plant Design (AAM A34): Activity of producing plant definition based on final process design and conceptual process design.

F.1.97 Produce Final Process Design (AAM A33): Integration of conceptual process and facility designs to fully define parameters of plant flow scheme.

F.1.98 Produce Process Flow Diagram (AAM A316): Production of a schematic showing basic process flow developed from the cumulative results of Unit Operations, Equipment Sizing, Initial Logic and Safety Requirements along with related chemical properties. If design activity is related to a modification or addition to an existing facility then the existing facility information is reflected in the developed Process Flow Diagram.

F.1.99 Product: Marketable output of plant.

F.1.100 Project Authorizations/Controls*: Management authorization, imperatives, directives, and procedures for initiating and executing project activities.

F.1.101 Project Financial Plan*: Plan that states how much the plant will cost to construct, how it is to be paid for, and when payments are to be made. It is a general financing and cash flow plan.

F.1.102 Project Specific Procs/Specs/Gdlns: Specifications created specifically for the plant project. They may call out and add to, modify, or tailor a standard. Portions are derived from design basis.

Project specific procedures, specifications, and guidelines evolve through stages like P&IDs and other design documentation.

F.1.103 Provide Resources (AAM A12): Acquire and deploy personnel, facilities, and funding to perform the project activities.

F.1.104 Purchase Agreement*: Contract between two parties to provide a service or item for designated payment.

F.1.105 Qualified Construction Firms*: List of construction firms that are capable and acceptable to construct plant.

F.1.106 Regulatory Agreements*: Mutual agreement between owner/operators and regulatory agencies

F.1.107 Regulatory Authorizations*: Approval from regulatory agencies to initiate activities.

F.1.108 Regulations/Regulatory requirements*: Federal, state, or local laws, codes, or standards that impact various activities related to the process plant. Regulatory requirements may apply to, but are not limited to, permitting, engineering, construction, operations and decommissioning.

F.1.109 Resources*: Technology, people, facilities.

F.1.110 Restored Site*: Remediation of the site to environmentally acceptable conditions.

F.1.111 Revamp Plant unit/module (Revamp Plant FEO1): Determine the need for an engineering project to change the functional characteristics of the process within a given plant facility (and thus make changes to the facility). Examples include: 1) Convert a power plant from run-of-river cooling to a cooling tower; 2) Convert a pharmaceutical plant from producing drug A to drug B.

F.1.112 Routing Definition*: An arrangement of space areas of a building that are reserved for installing pipes and services in specified elevations and directions. The purpose of a routing definition is to establish areas and predesignated volumes (i.e., lanes) for all major piping, electrical conduits, electrical and/or instrument cable trays, ductwork, fire lines, and plumbing. Commonly called a "lane system".

F.1.113 Safety Compliance Reports*: Documentation of analyses and evaluations of plant with respect to safety considerations.

F.1.114 Safety Hazop Analysis (Report)?: The results of the analysis of the plant design with respect to safety and hazardous operations. Identifies possible causes of faults and consequences, and recommends remedies.

F.1.115 Safety System Spec: Job specific specification(s) related to facility safety. May be developed from applying the design safety philosophy to plant design.

F.1.116 Satisfy Safety Requirements (HAZOPS) (AAM A335): Perform a formal plant process design, operation, and control review (HAZOPS or Hazardous Operations review). Plant safety requirements involve issues such as source terms for spill scenarios, vapor dispersion for combustible and toxic releases, reliability of metallurgy and other materials, component failure rates, operator response and error, fail-safe instrumentation, equipment spacing, number and size of equipment trains, radiation from fires, relief system design philosophies, deflagration test results, thermal runaways and associated vent sizing, detonations and resulting shock waves. A formal HAZOPS review is performed against plant designs which affect these issues.

F.1.117 Schedules*: A time-based list of project tasks that describes:
- — what is supposed to happen;
- — when it is supposed to happen;
- — task sequence and dependencies;
- — restraint and constraints;
- — float;
- — critical path.

Kinds of schedules include:
- — reqd on site;
- — planned.

F.1.118 Schematic Diagrams: A physically non-dimensional, 2D graphical representation of the logical/functional design of a system that do not (necessarily) encompass physical information.

Examples include:
- — PFD;
- — P&ID;
- — electrical single line;
- — motor control;
- — control loops;
- — HVAC;
- — plumbing;
- — I/O.

Schematic diagrams evolve through stages like P&IDs and other design documentation.

F.1.119 Site Information: Information about the physical location where the plant will be constructed and the conditions of any plant on the site (if one exists). It includes:

— geological data, such as before and after terrain contours, and subterranean structure, and seismic activity.
— meteorological data such as seasonal wind profile, precipitation, snowfall, ambient temperature, and such.
— Road data;
— cadastre (property lines) zones;
— utilities.

A kind of site information is verified field dimensions. They are parameters which specify the physical and spatial characteristics of an existing item or component in a plant which have been verified by measurements taken by a second, independent agency. For example, field dimensions provided by the plant owner for piping tie-in locations (coordinate locations and sizes) are considered as VERIFIED when duplicated by the AEC representative. If discrepancies are discovered during verification of the field dimensions, the initial and verification measurement processes must be repeated to assure verified dimensions.

Existing Plant Conditions are the characteristics of existing plant relevant to plant project. Used with revamps, retrofits, or expansion.

F.1.120 Spatial Information: The specific shape and location of thing or arrangement of things within a (plant) coordinate system. A "thing" may be a physical object (item) or a volume of functional/reserved space. Spatial information is a prerequisite to spatial design - everything that must be known about a thing in order to do a spatial design.

Spatial design is the engineering activity of determining an effective arrangement of physical items in a space. The effective arrangement is defined as a safety, cost, and process responsive placement of piping, equipment, structural, ducting, conduit and related physical items in a functional space.

F.1.121 Specifications & Standards: Consensus or mandated technical descriptions of plant hardware, systems, or facilities that control the design or construction of a plant.

F.1.122 Specify Building and Plant Services (AAM A343): Establish utility and other service needs for the building and plant based on owner requirements, final system design, and final spatial design.

F.1.123 Specify Control Requirements (AAM A334): Instrumentation and control systems characteristics are defined to fulfill requirements for plant operation are defined by the operating procedures and safety requirements. Control systems are used to help maintain plant safety, in insure product quality, and to safeguard equipment. These systems are used to control process reactions, flows, temperatures, pressures, levels, etc. They operate automatically, or provide indications to plant personnel. Control Requirements are generally defined in the operating procedures and specified on the P&ID and in the instrument list.

F.1.124 Specify Equipment Functional Characteristics (AAM A333): The Functional Characteristics of each major item of equipment are defined based on confirmed plant operating requirements, process technologies, and process optimization. Functional characteristics include equipment type, process stream

inputs/outputs/capacities/conditions, equipment metallurgy, piping and instrumentation, power requirements, and auxiliary systems.

F.1.125 Specify Piping and Instrumentation (AAM A332): Piping and instrumentation functional requirements are developed based on plant production capacities, process type/technology, control methodology, chemical content of process streams, and equipment layout. Alternative operating conditions, maintenance requirements, plant operating and personal safety are issues considered. The results of this activity are detailed on Piping and Instrumentation Diagrams (P&ID), line lists, equipment lists, and instrument lists.

F.1.126 Status*: A report of the current state of a task, design, action, schedule, etc. It is a quality assurance feedback mechanism.

F.1.127 Stream Data?: Chemical composition, physical state, and mass quantities of process flows. Part of a PFD.

F.1.128 Structural/civil configurations: Spatial representations of the site earthwork, facility foundations, below grade non-process piping and facility structural skeleton. See system layout/design

F.1.129 Suggestions, errors, & omissions*: Comments and qualifications offered by the Engineering Contractor in response to an Owner's Request For Proposal (RFP). Similarly, this term can be used by a Subcontractor in the preparation of a bid document to the Engineering Contractor. See change request.

F.1.130 Suppliers List*: A list of vendors that provide commodities or services to an organization.

Kinds or statuses of supplier lists include:
- — Approved;
- — Recommended;
- — Partnered.

F.1.131 System Layout/Design: The definitions/representation of the system sufficient for construction. This definition results from the use of the system design basis, P&IDs, specifications, and other documentation/information to specify the physical components/items and spatial configuration of the process plant.

Note - the definition of "system" is broader than common usage, e.g., it encompasses structural systems.

System layout/designs can be viewed or categorized according to three different breakdowns:

1. Evolutionary Phase
   - — Initial;
   - — Design;
   - — Final.

2. System Type

— Piping;
— HVAC;
— Electrical
— I&C;
— Structural/Civil;
— Architecture;
— Safety.

3. Functional Views
— conceptual arrangement;
— Spatial information;
— Schematic diagram;
— P&ID (includes piping connectivity/sequencing).

For example, the final HVAC spatial information system design/layout will specify the definition, physical dimensions, location coordinates, and characteristics for all Heating, Ventilating, and Air Conditioning (HVAC) components which occupy space in the plant. Only those physical dimensions, location coordinates, and characteristics required to specify the spatial instance of each component are included in this definition.

F.1.132 Time/Cost Estimates*: Projected or forecasted cost and length of time to:

— design, produce, or procure a plant item;
— obtain a service;
— achieve some goal.

F.1.133 Underground requirements: Requirements generated by spatial configuration design that specify necessary characteristics of underground facilities. It may include geotechnical (i.e. sand, rock, water. etc.) requirements and climatological (i.e. frost line) conditions that would dictate engineering or construction. See system layout/design.

F.1.134 Vendor data: Documentation received from vendor concerning procured_items; drawings, manuals, calculations, anything necessary to define their deliverable item (s) and services.

Kinds of vendor data include:

— Preliminary: in process design information;
— Certified: information from the supplier of equipment or other components which is warranted to correctly describe the as-delivered functional and/or physical data;
— released for fabrication/construction.

F.2 Application activity model diagrams

The application activity model is given in figures F.2 through F.12. Activities and data flows that are out of scope are marked with asterisks.

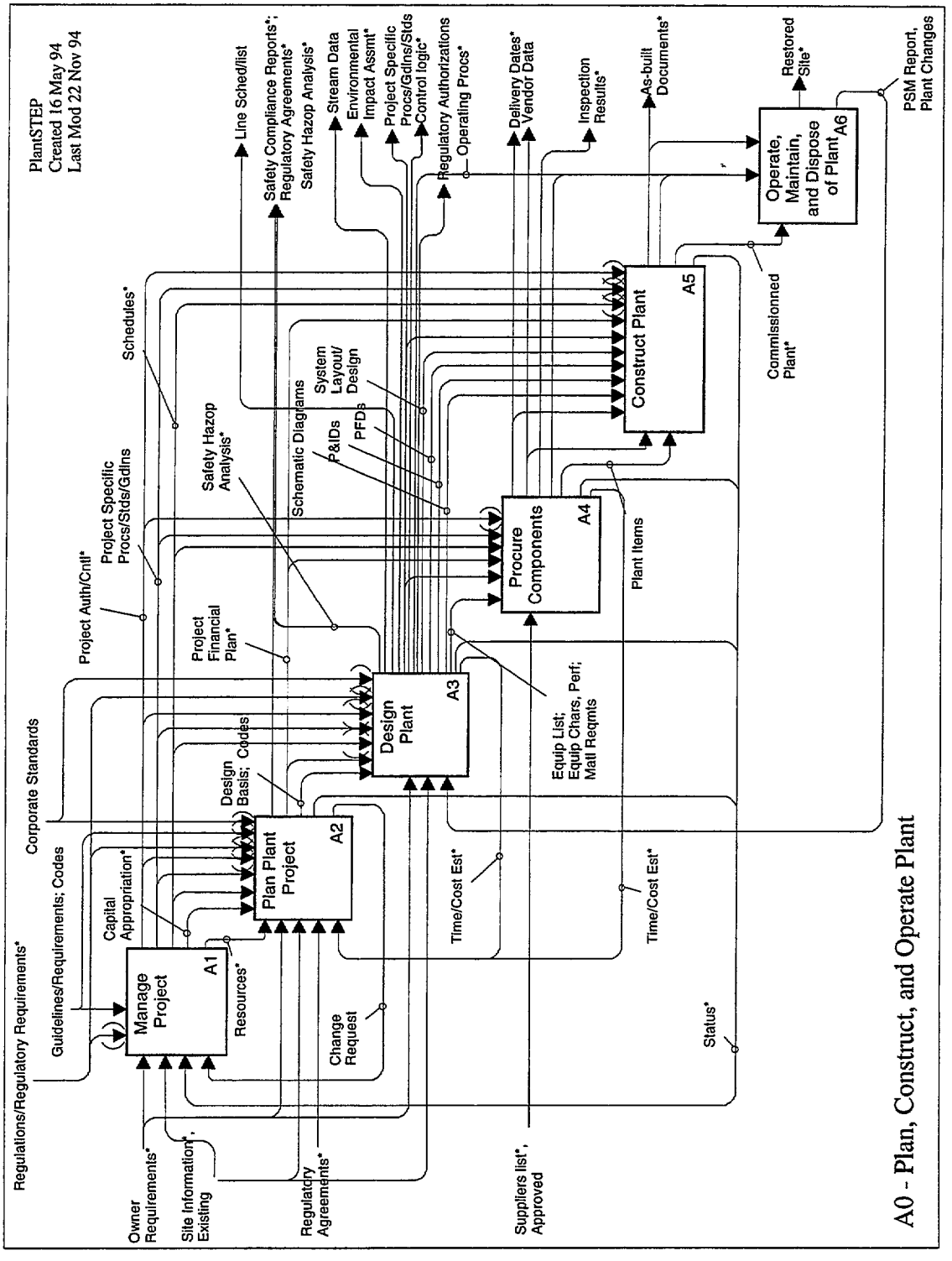

Figure F.2 - A0: plan, construct, operate plant in IDEF0

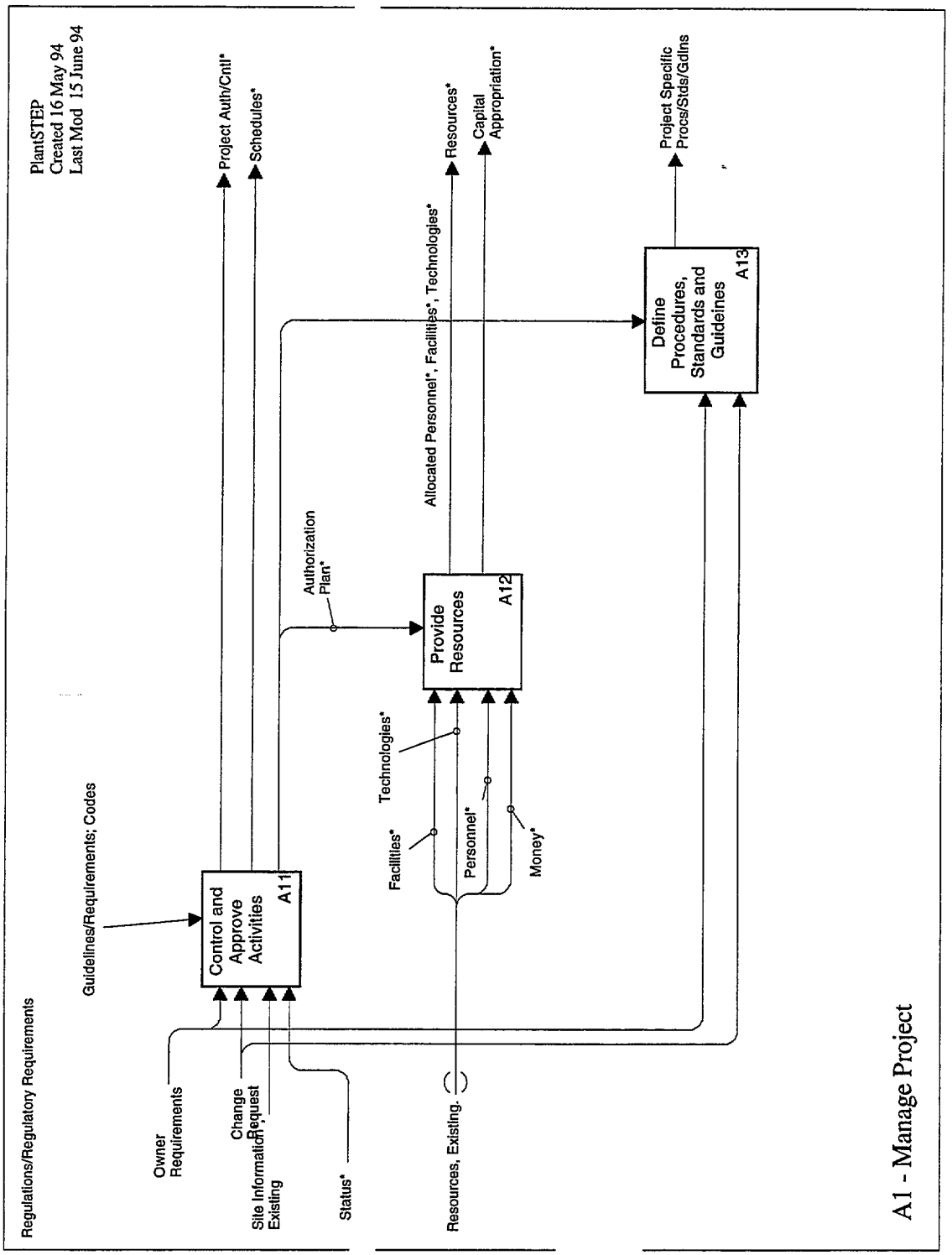

Figure F.3 - A1: manage project in IDEF0

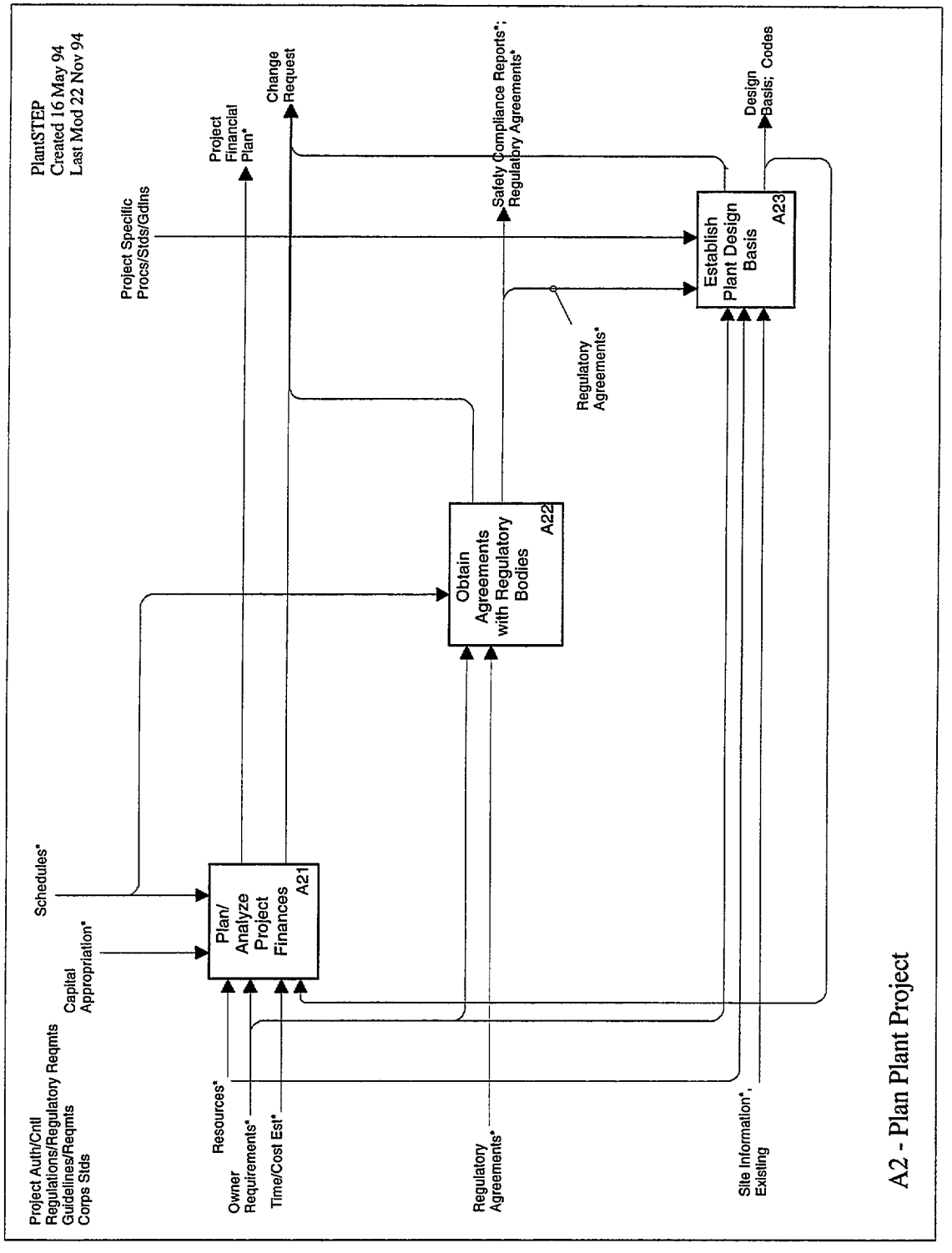

Figure F.4 - A2: plan plant project in IDEF0

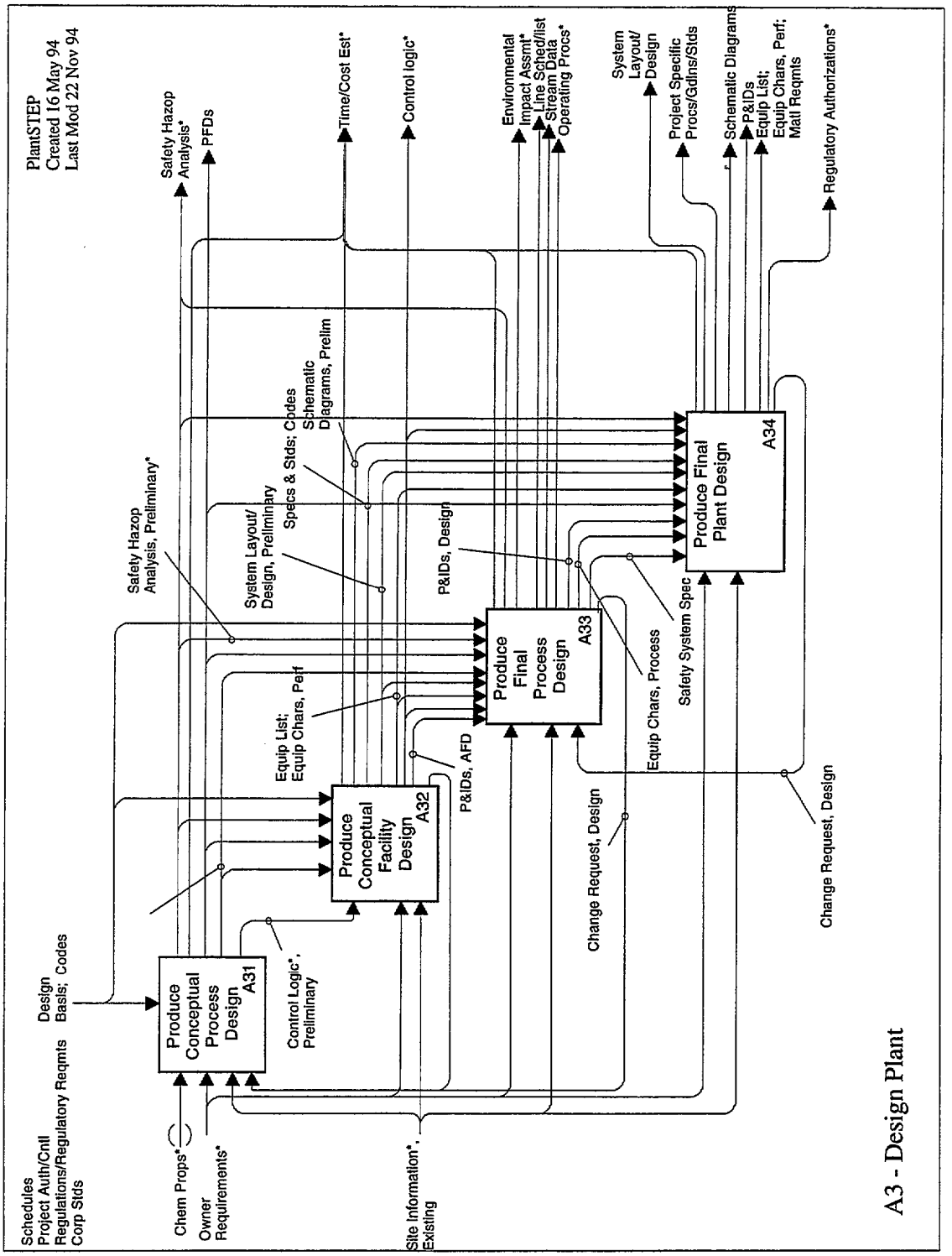

Figure F.5 - A3: design plant in IDEF0

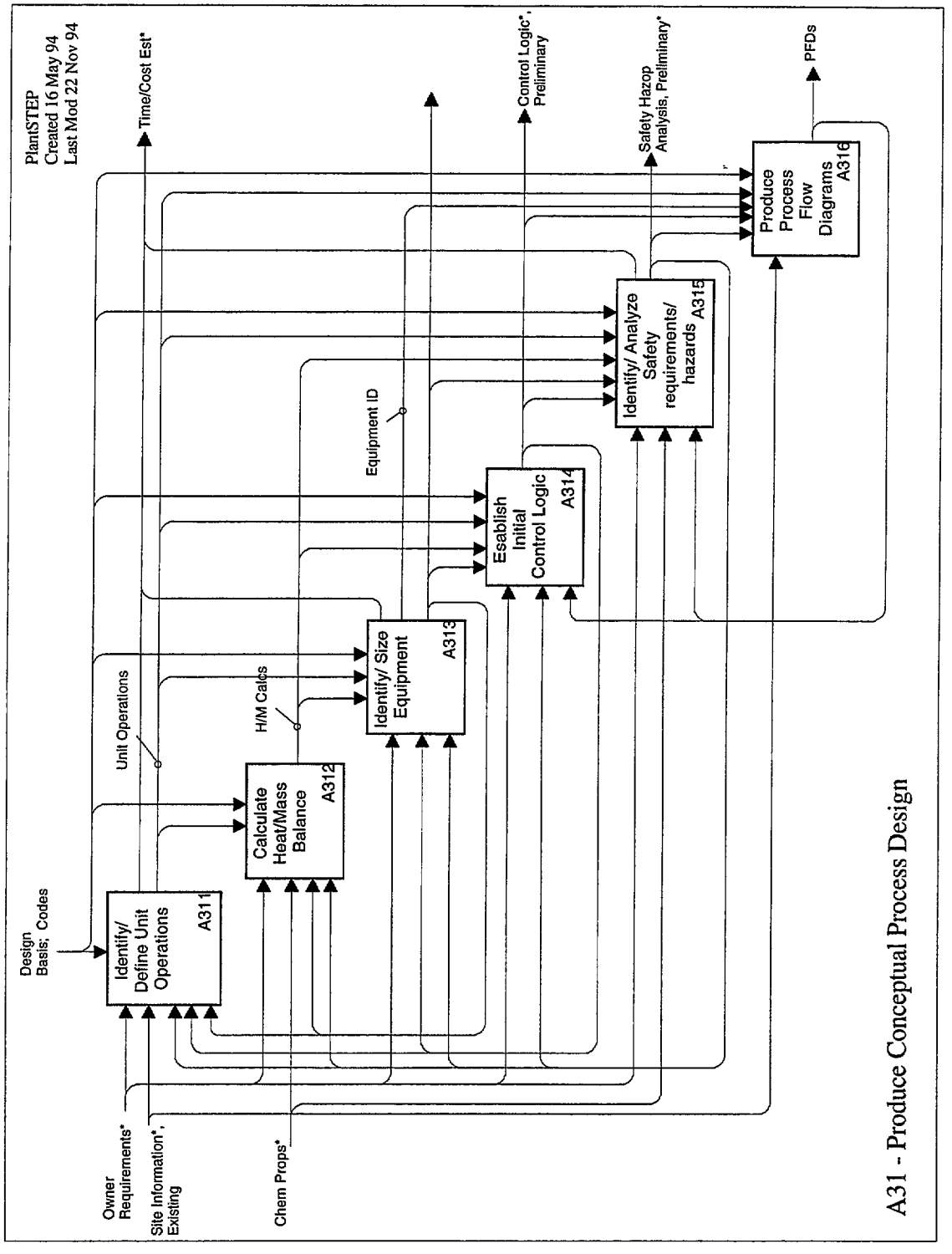

Figure F.6 - A31: produce conceptual process design in IDEF0

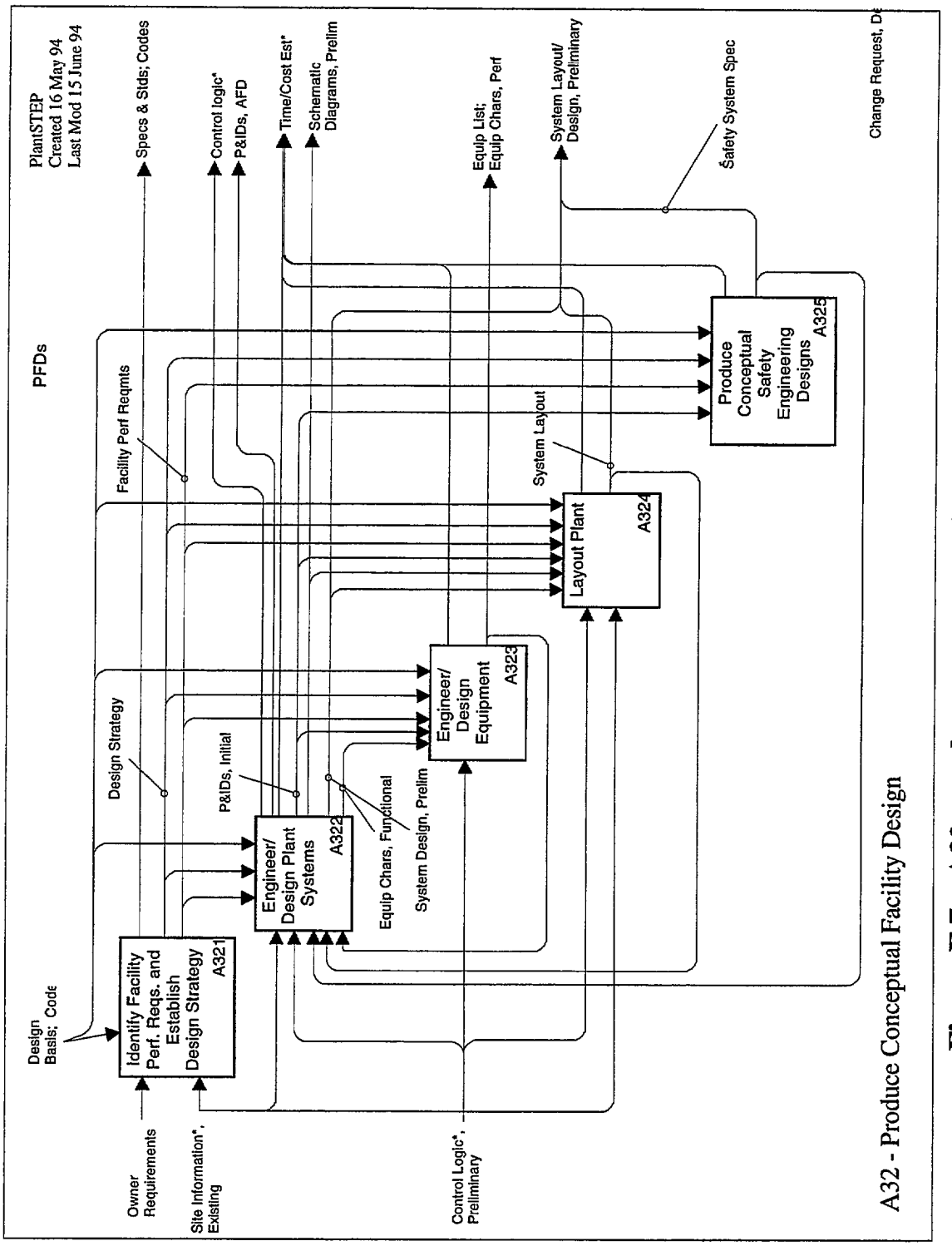

Figure F.7 - A32: produce conceptual facility design in IDEF0

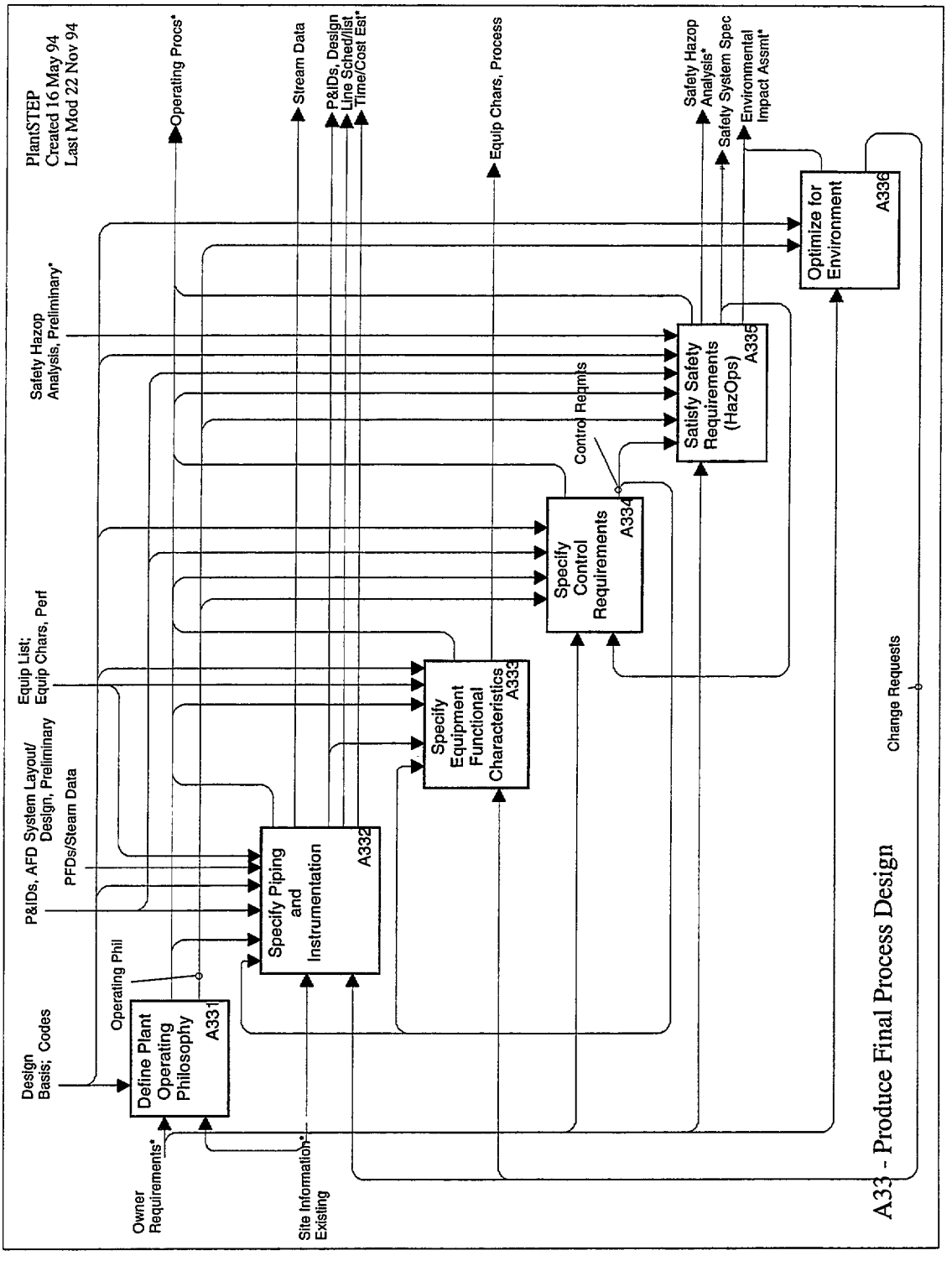

Figure F.8 - A33: produce final process design in IDEF0

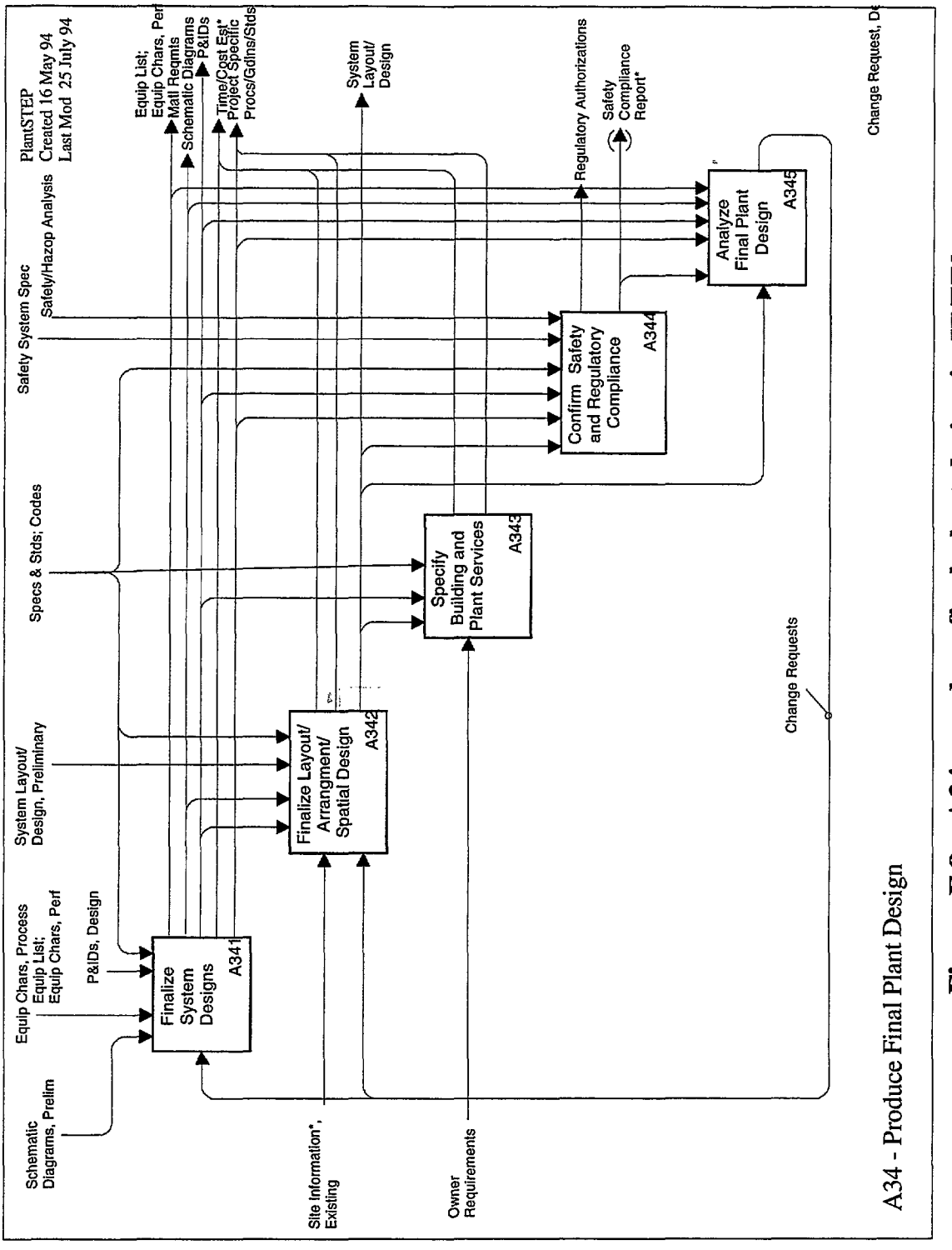

Figure F.9 - A34: produce final plant design in IDEF0

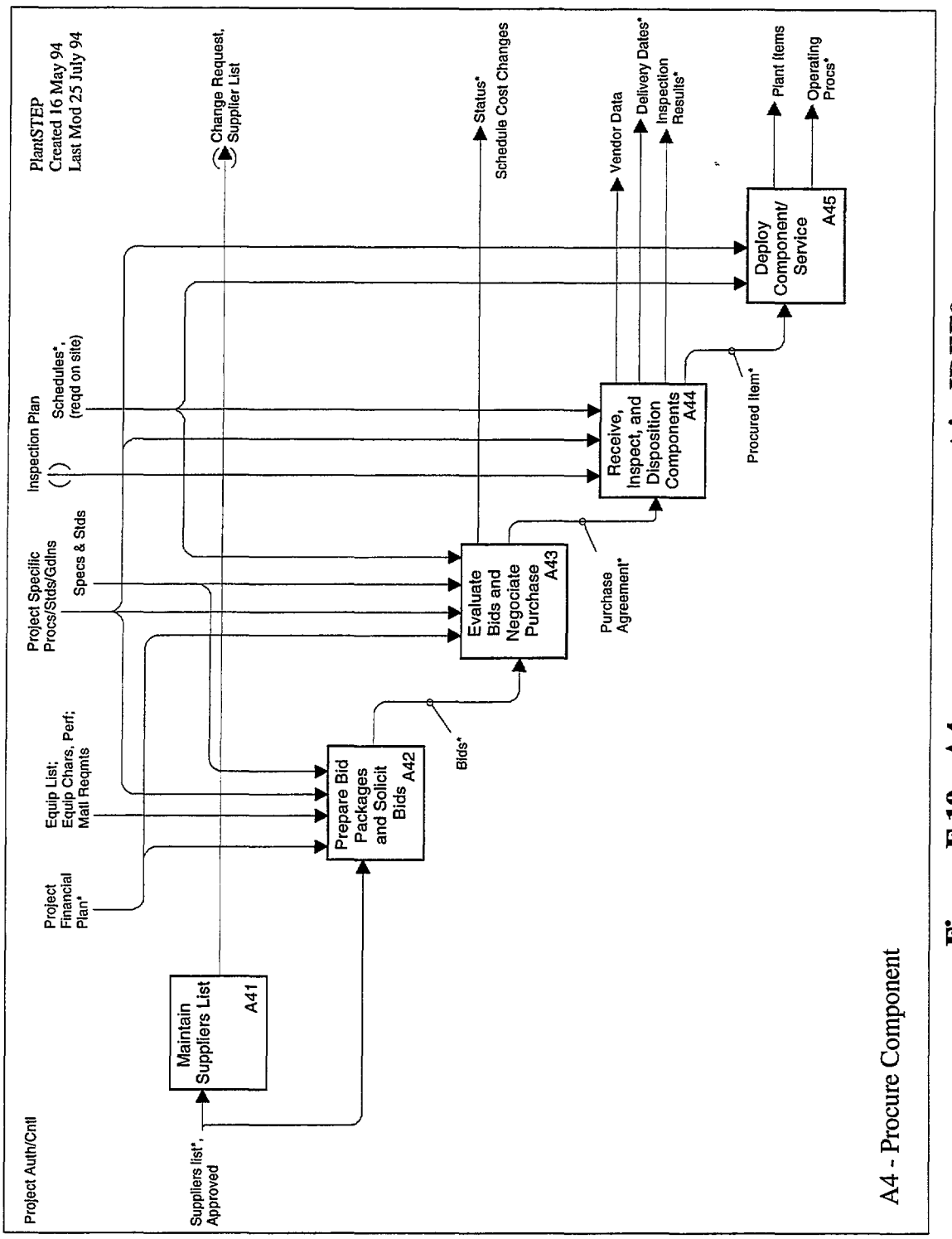

Figure F.10 - A4: procure component in IDEF0

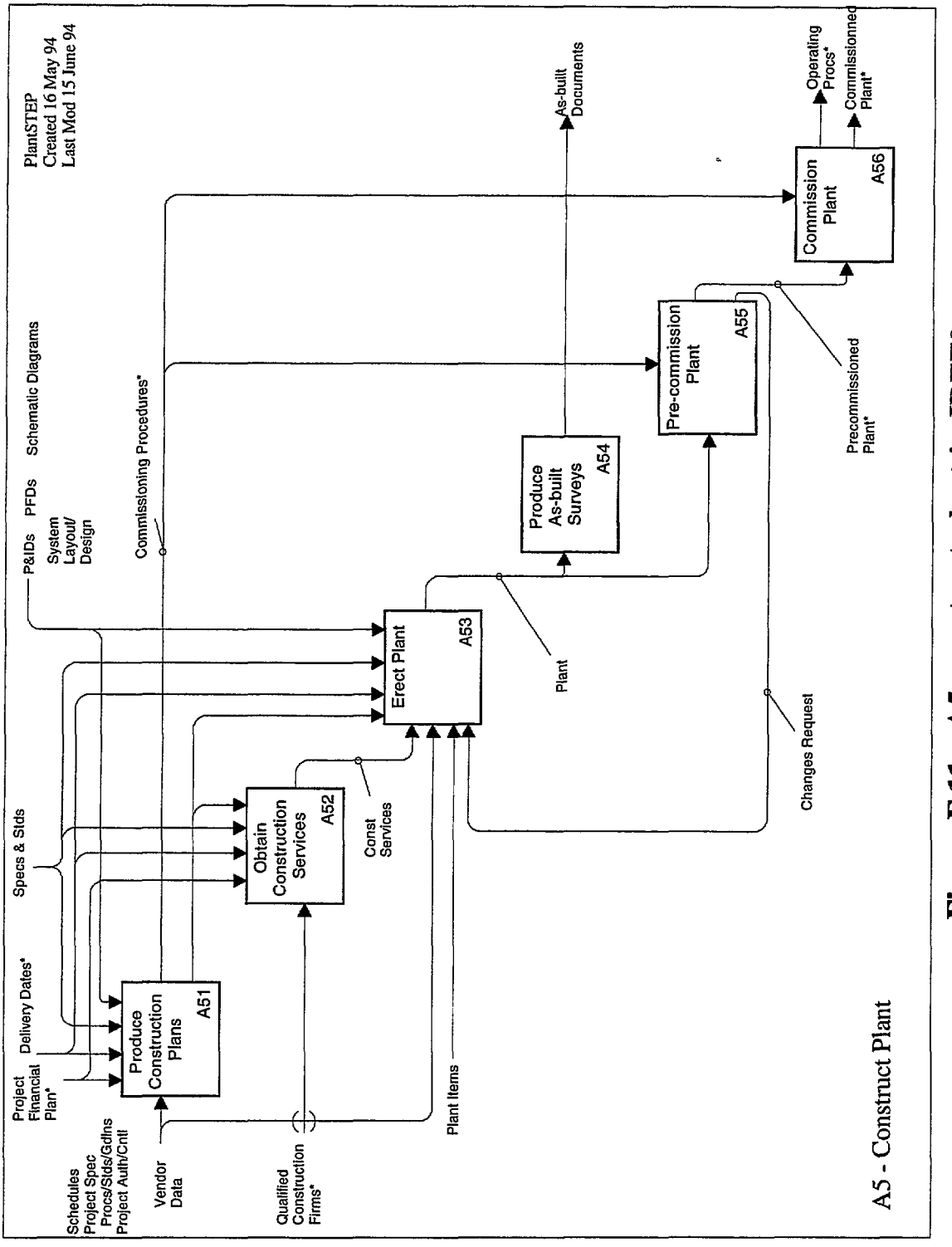

Figure F.11 - A5: construct plant in IDEF0

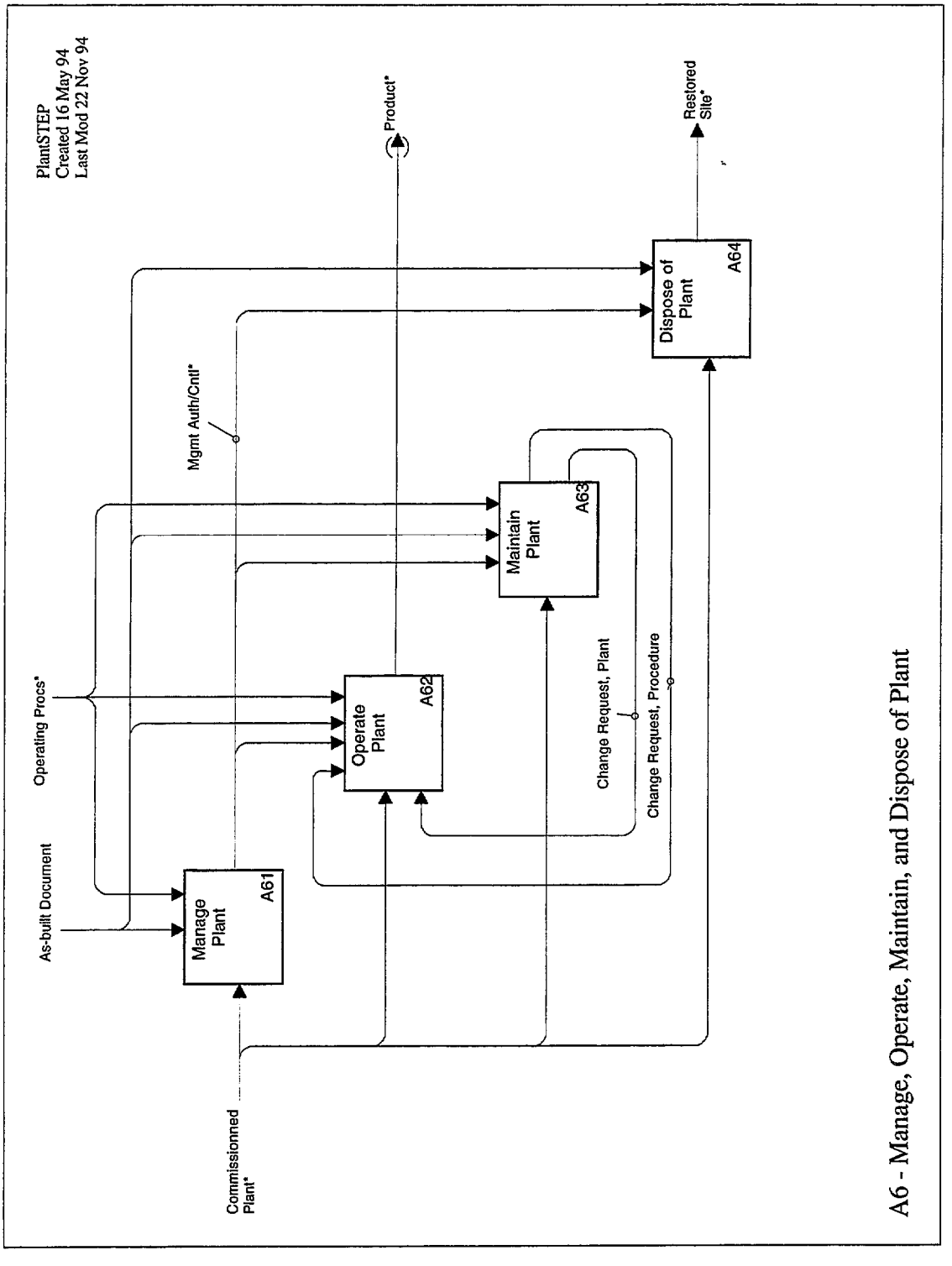

Figure F.12 - A6: manage, operate, maintain, and dispose of plant in IDEF0

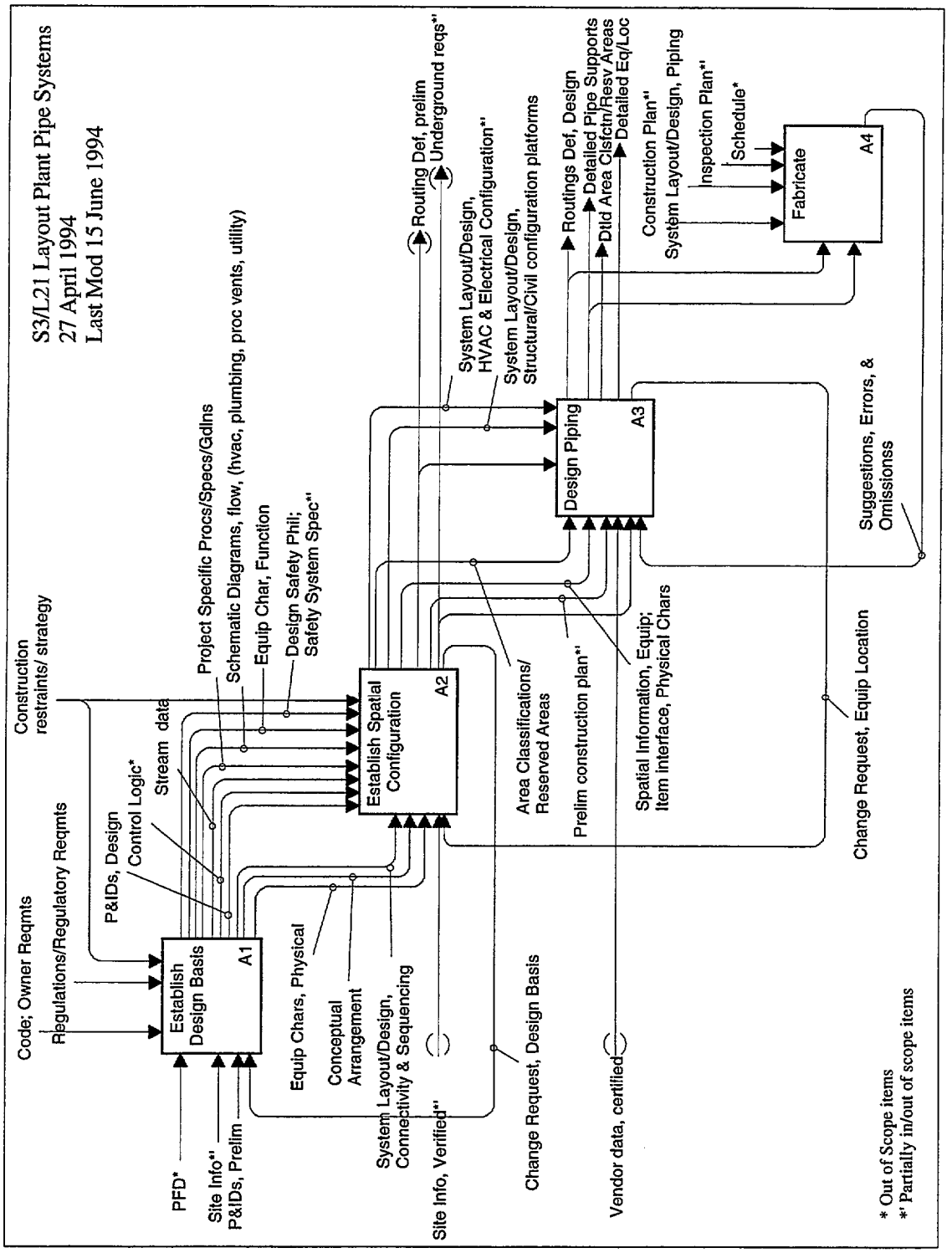

Figure F.13 - Scenario 1: layout plant pipe system in IDEF0

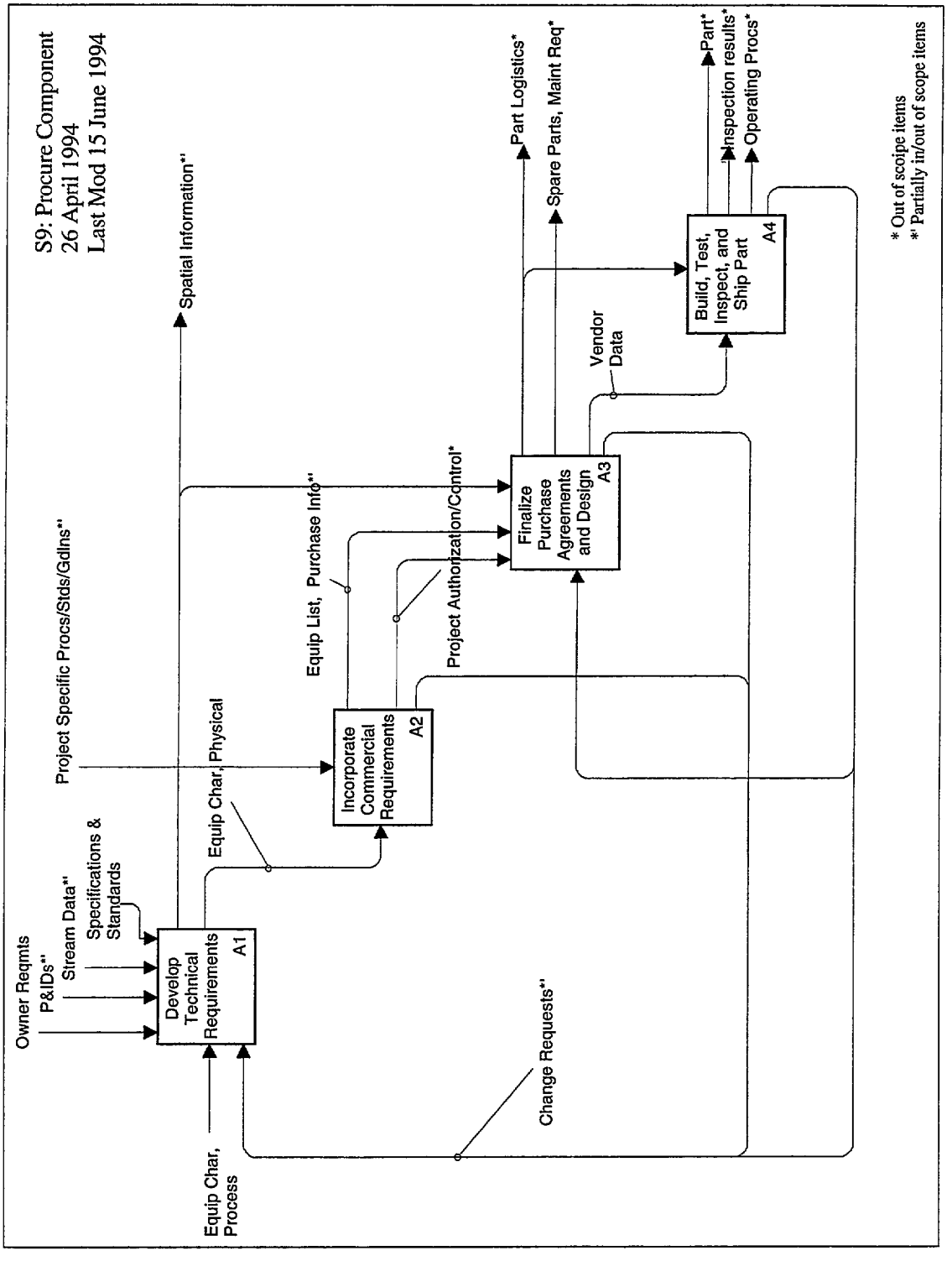

Figure F.14 - Scenario 2: procure component in IDEF0

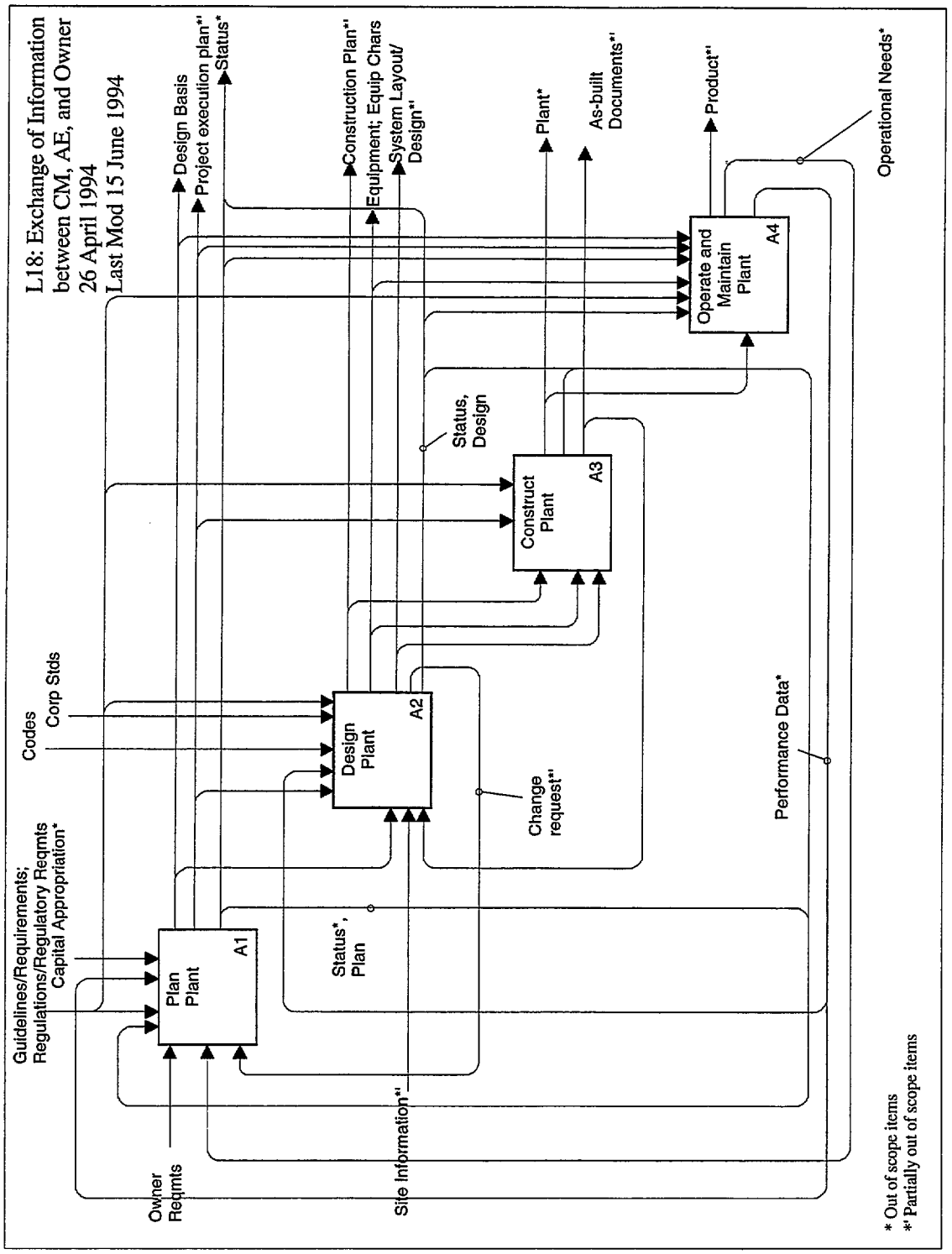

Figure F.15 - Scenario 3: exchange of information between CM, AE, and Owner in IDEF0

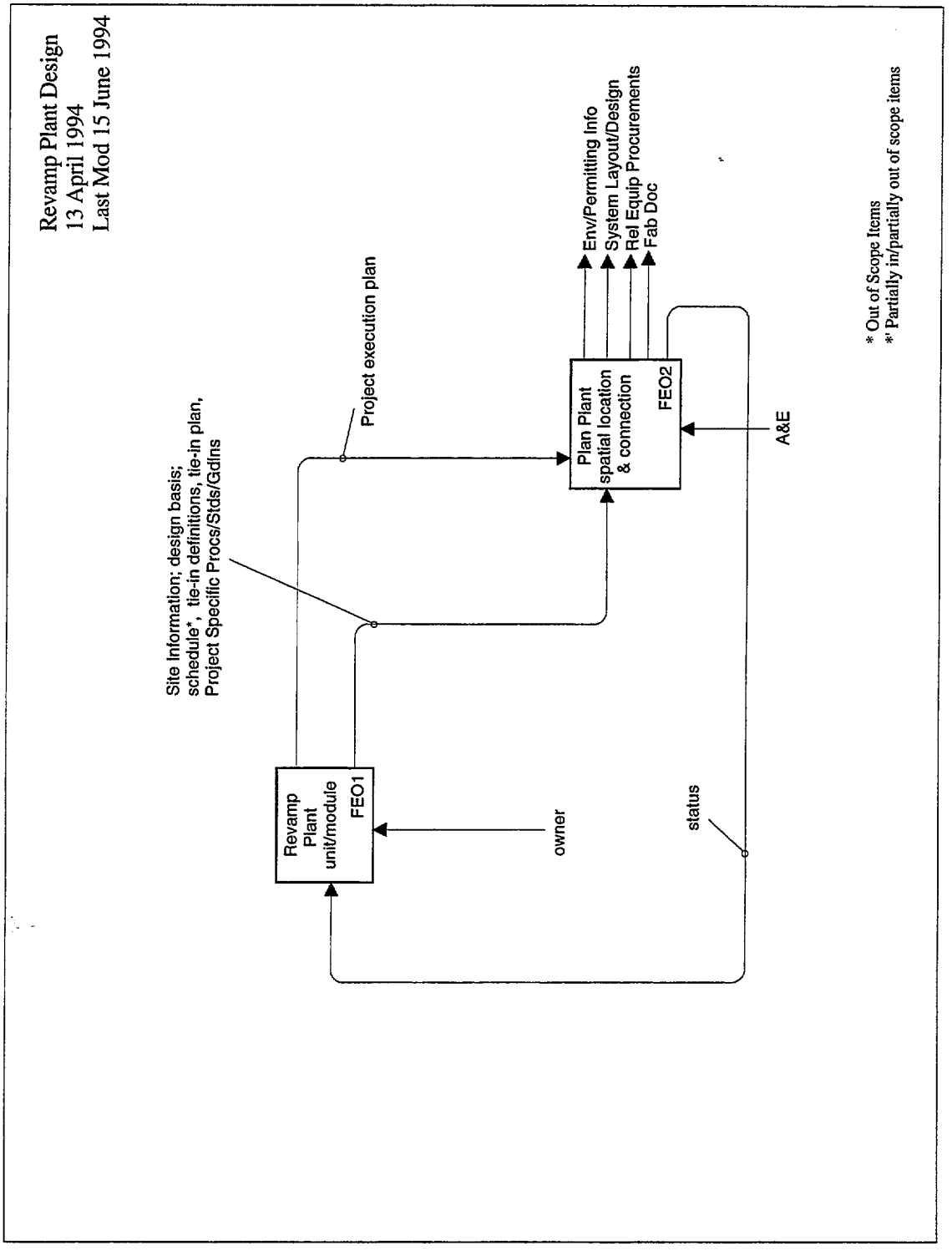

Figure F.16 - Scenario 4: revamp plant in IDEF0

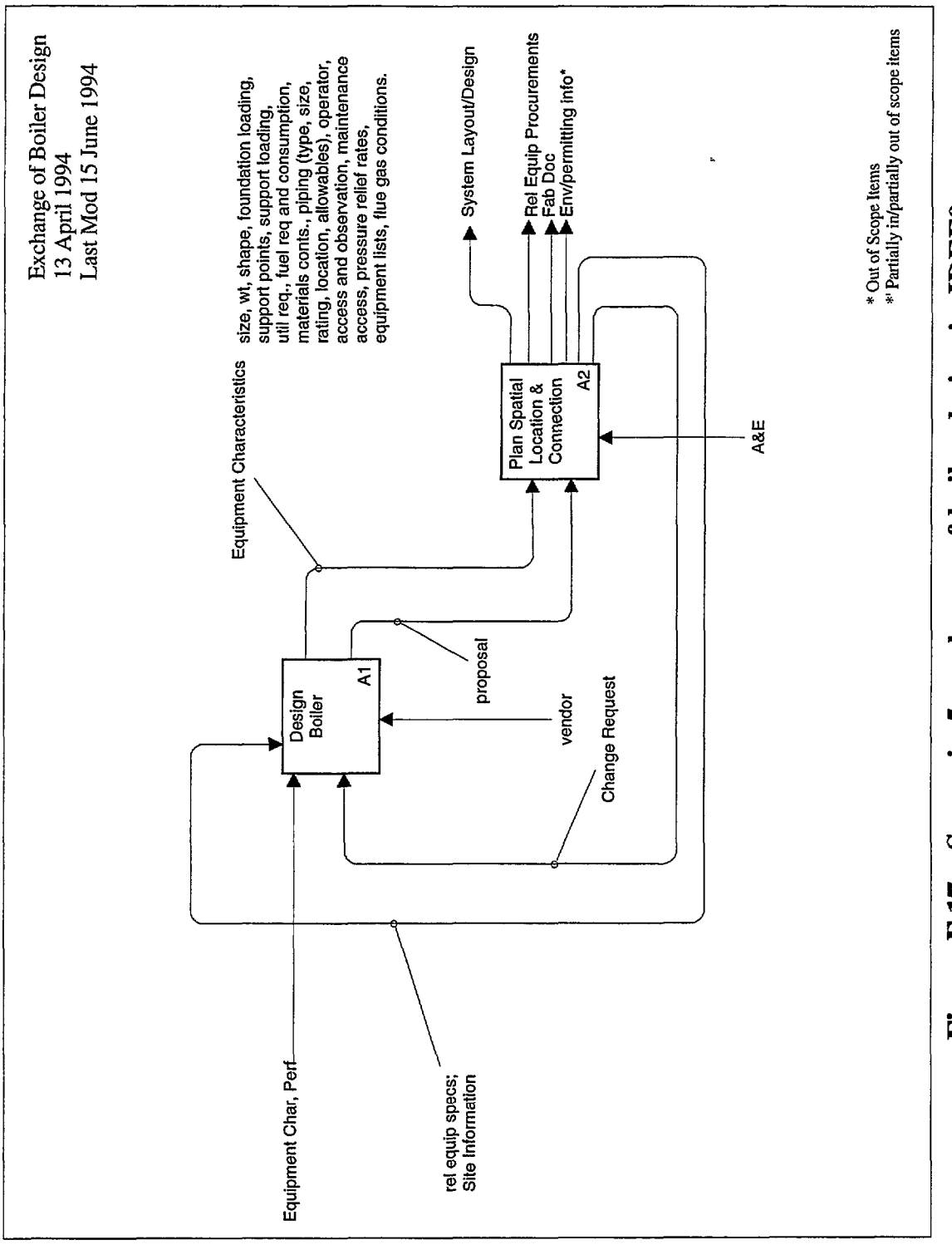

Figure F.17 - Scenario 5: exchange of boiler design in IDEF0

Annex G
(informative)

Application reference model

This annex provides the application reference model for the exchange of plant spatail configuration information. This application reference model presents a graphical representation of the structure and constraints of the application objects specified in clause 4 of this part of ISO 10303. The application reference model is independent of any implementation method.

NOTES

1 — The application reference model is represented using the IDEF1X modelling language.

2 — The application reference model is presented in a tiled diagram format. There are two diagrams; the first consists of figures 1 through 19, the second consists of figures 20 through 23. The complete diagrams may be assembled according to the the following templates:

Figure G.1	Figure G.2	Figure G.3	Figure G.4
Figure G.5	Figure G.6	Figure G.7	Figure G.8
Figure G.9	Figure G.10	Figure G.11	Figure G.12
Figure G.13	Figure G.14	Figure G.15	Figure G.16
Figure G.17	Figure G.18	Figure G.19	

Figure G.20	Figure G.21	Figure G.22	Figure G.23

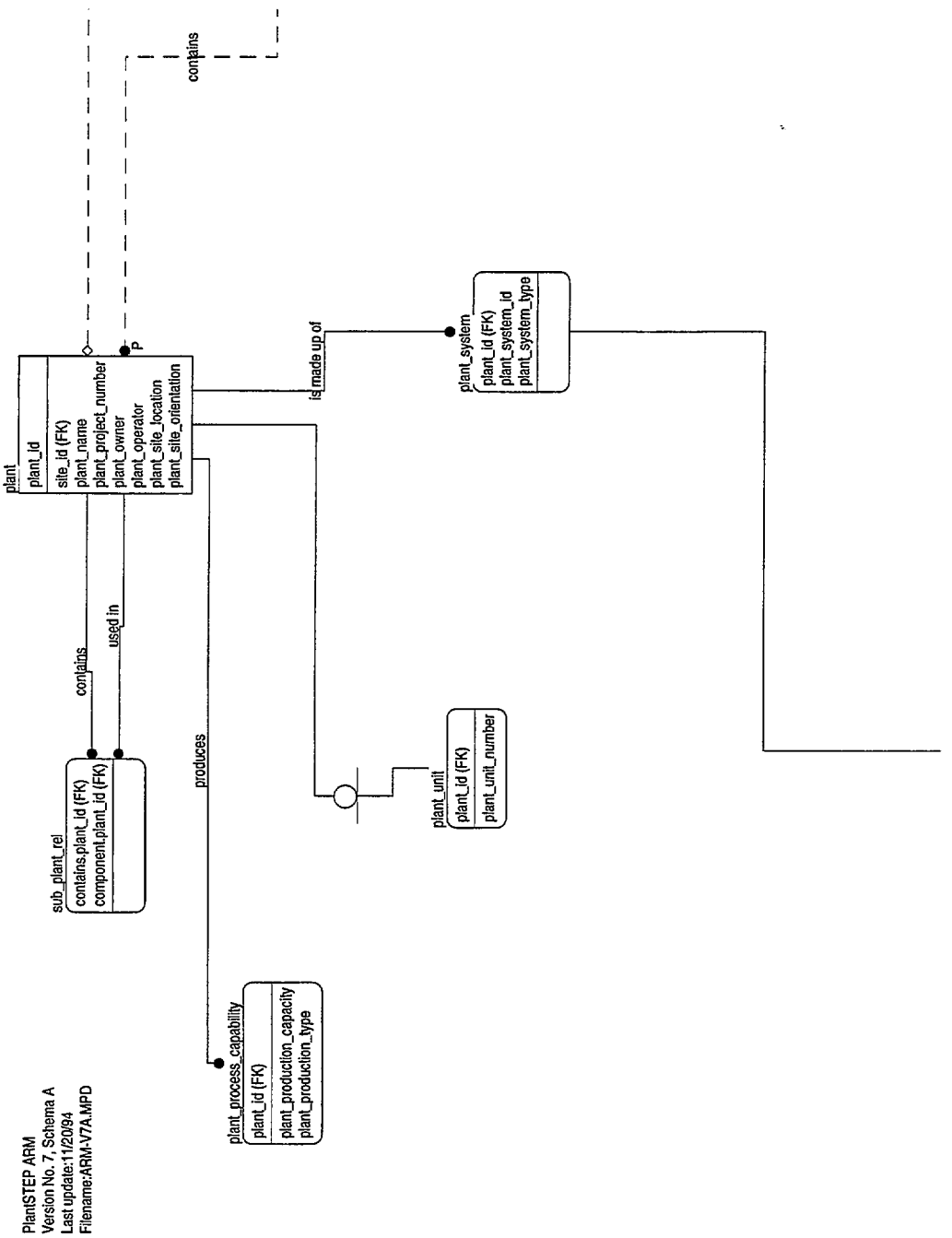

Figure G.1 - ARM View 1, diagram 1 of 19 in IDEF1X

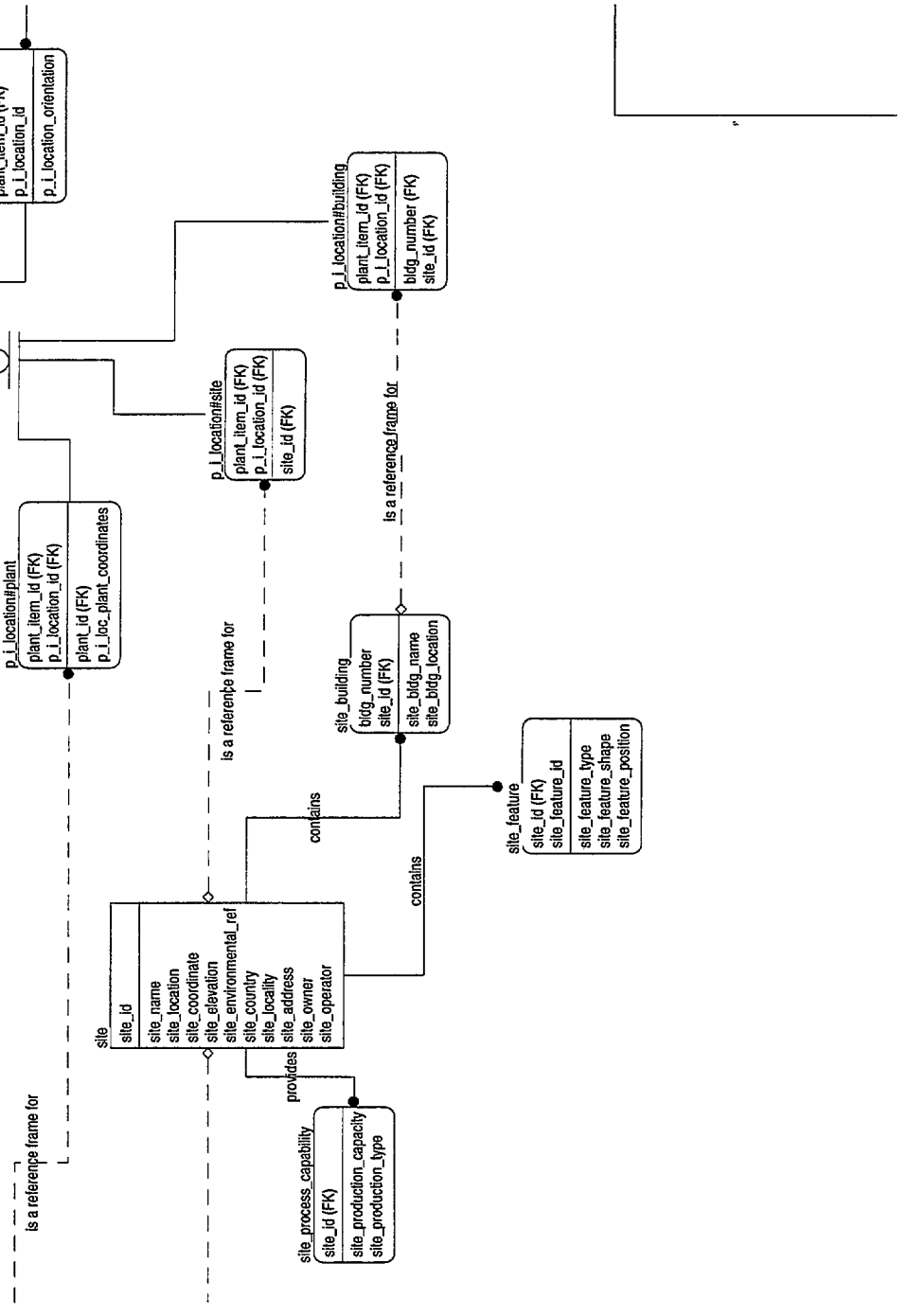

Figure G.2 - ARM View 1, diagram 2 of 19 in IDEF1X

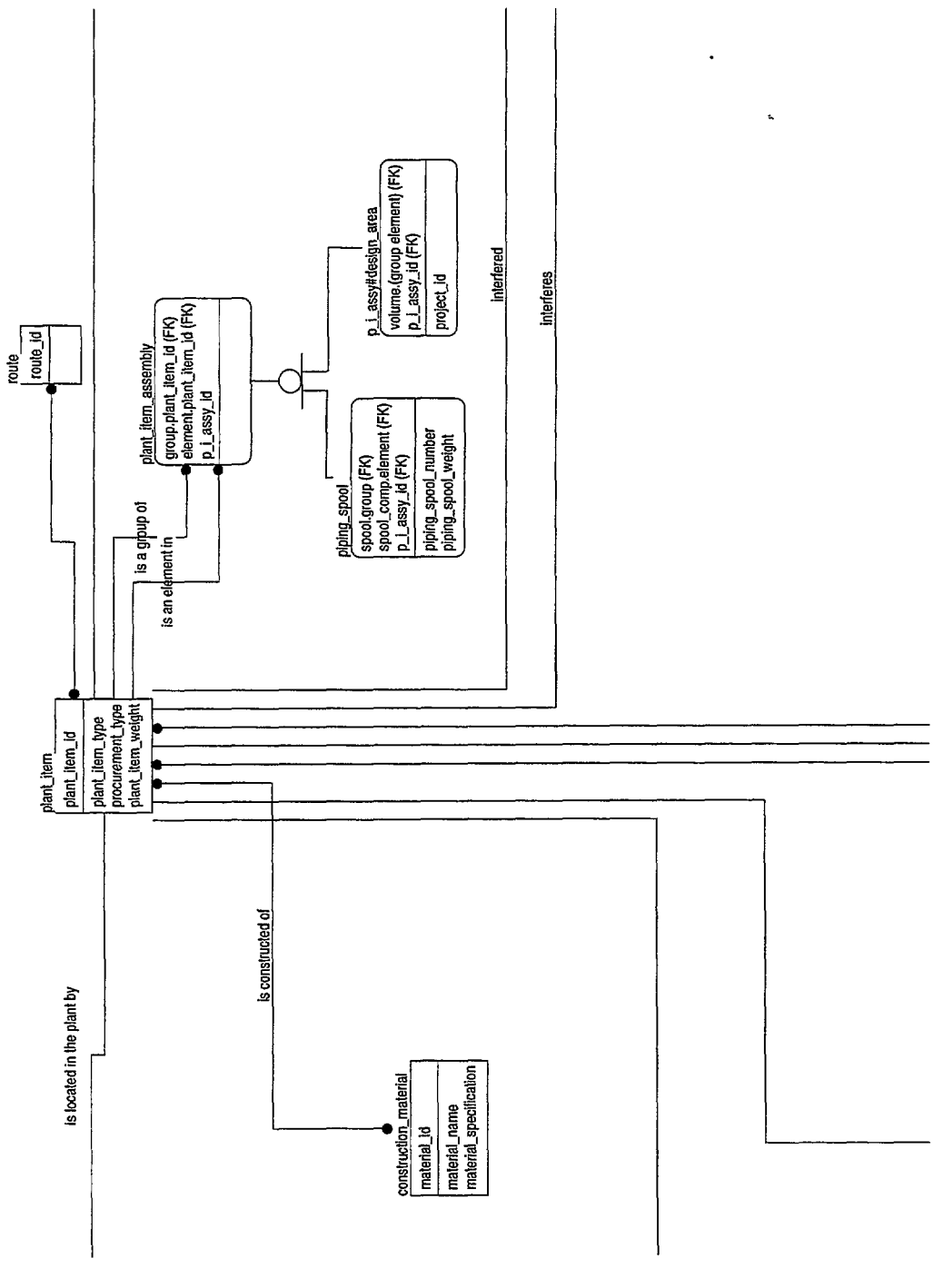

Figure G.3 - ARM View 1, diagram 3 of 19 in IDEF1X

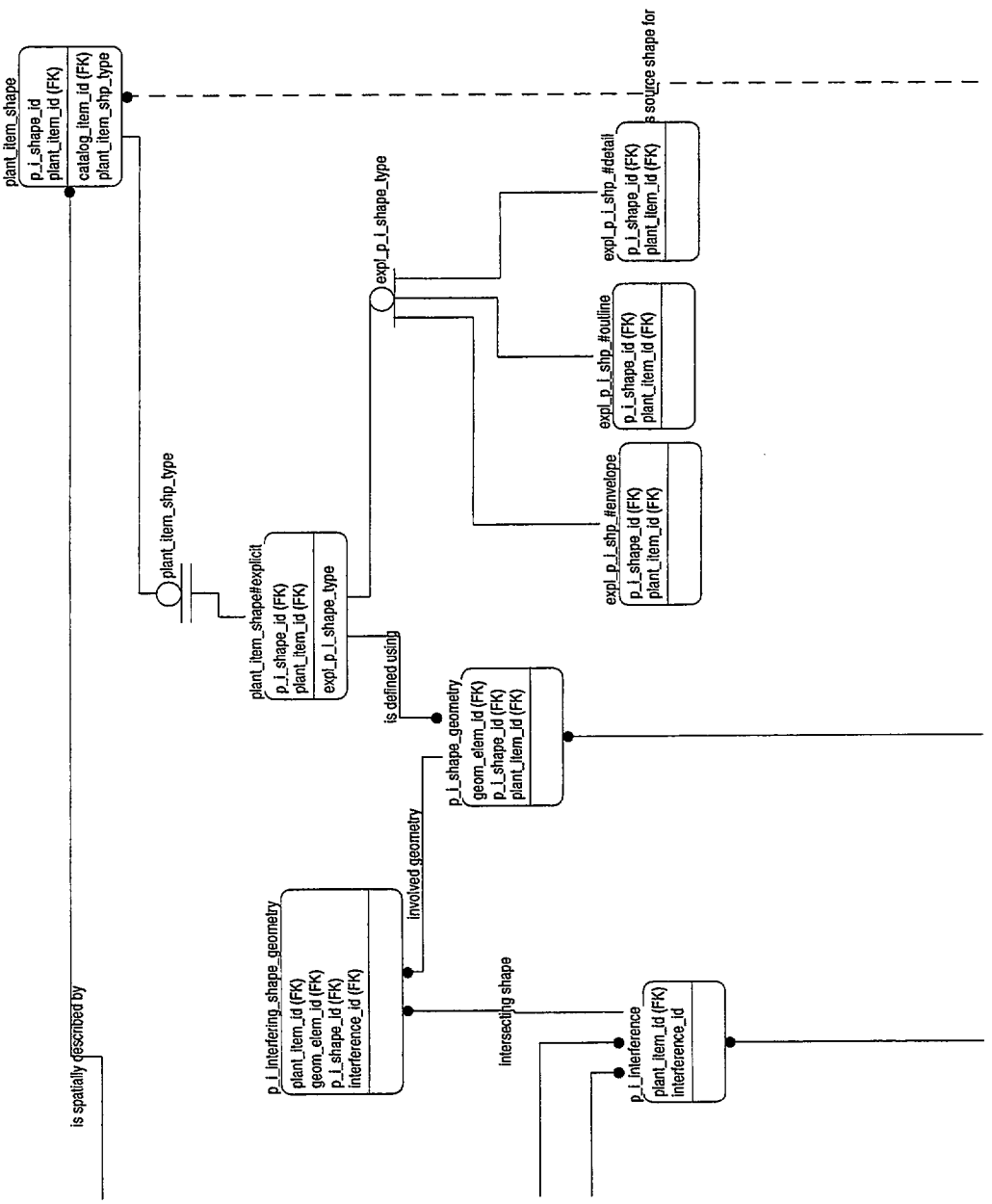

Figure G.4 - ARM View 1, diagram 4 of 19 in IDEF1X

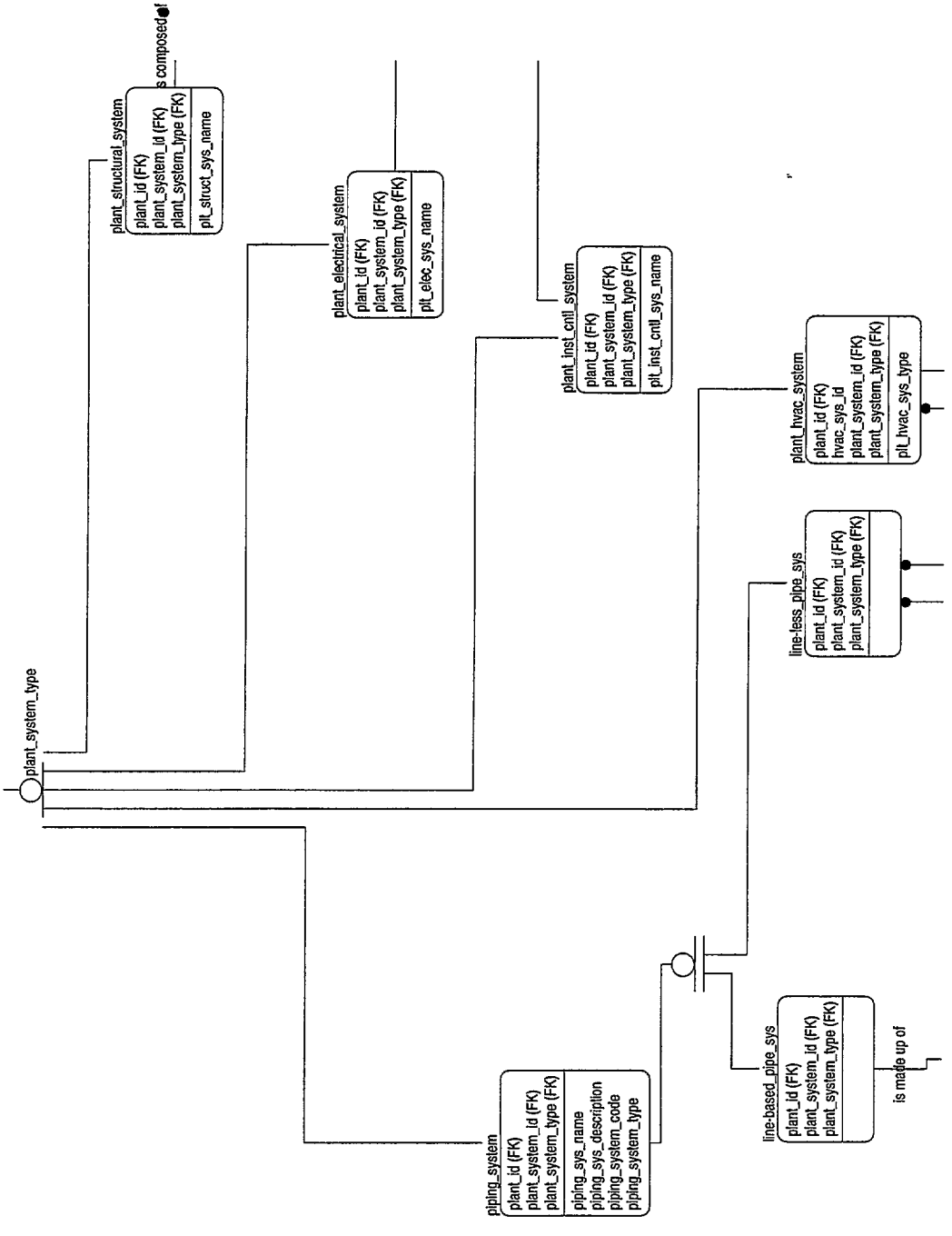

Figure G.5 - ARM View 1, diagram 5 of 19 in IDEF1X

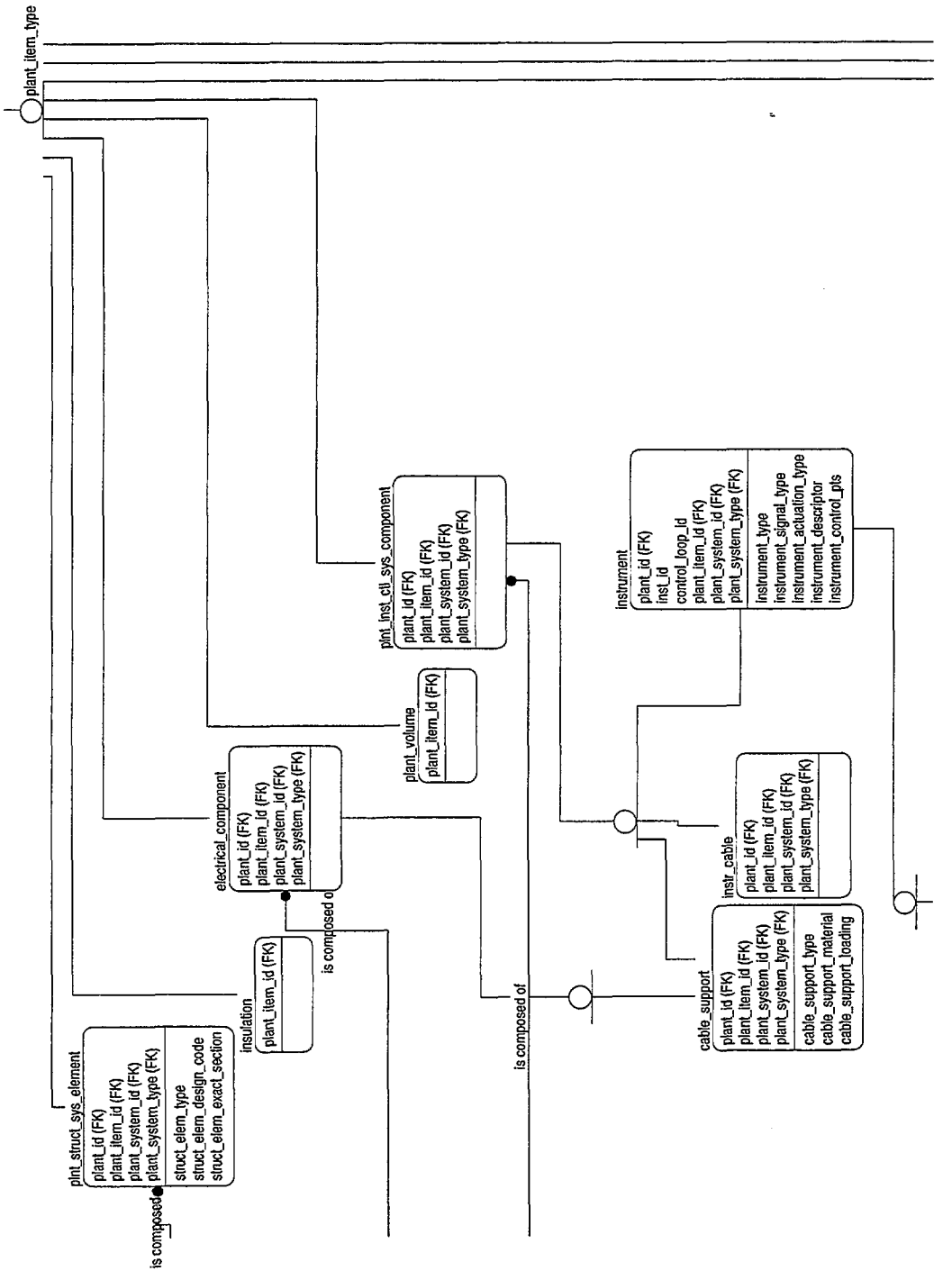

Figure G.6 - ARM View 1, diagram 6 of 19 in IDEF1X

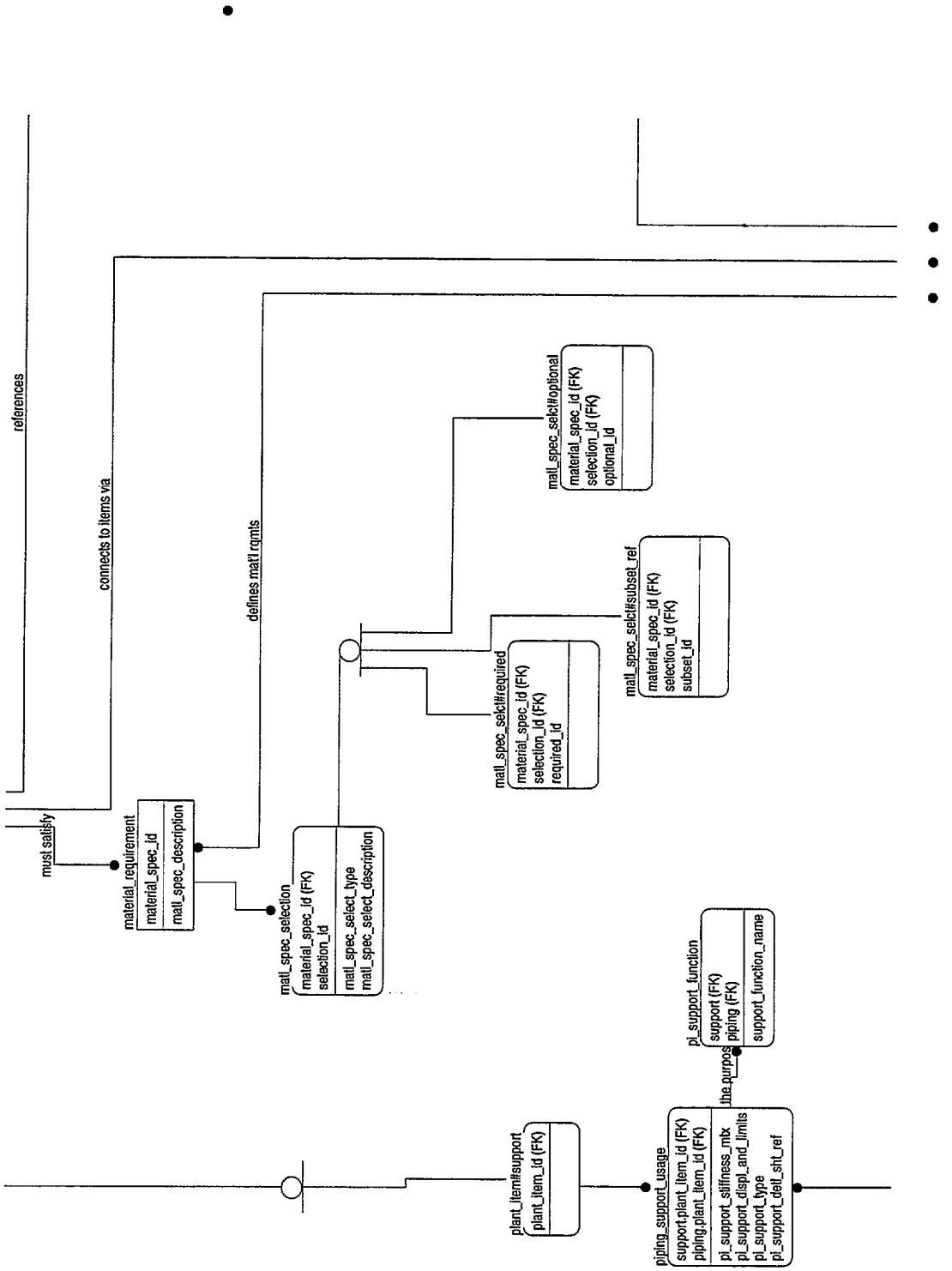

Figure G.7 - ARM View 1, diagram 7 of 19 in IDEF1X

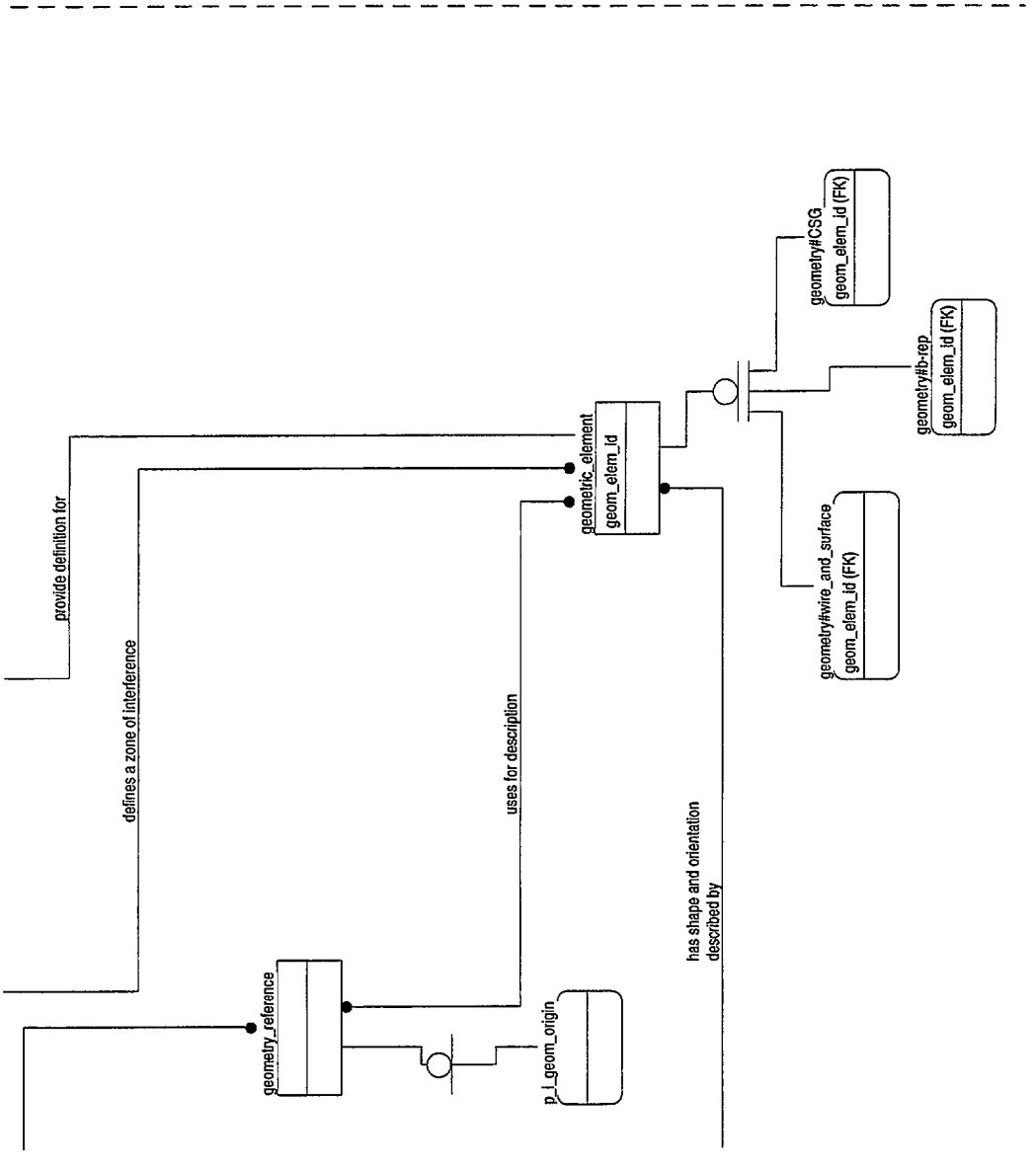

Figure G.8 - ARM View 1, diagram 8 of 19 in IDEF1X

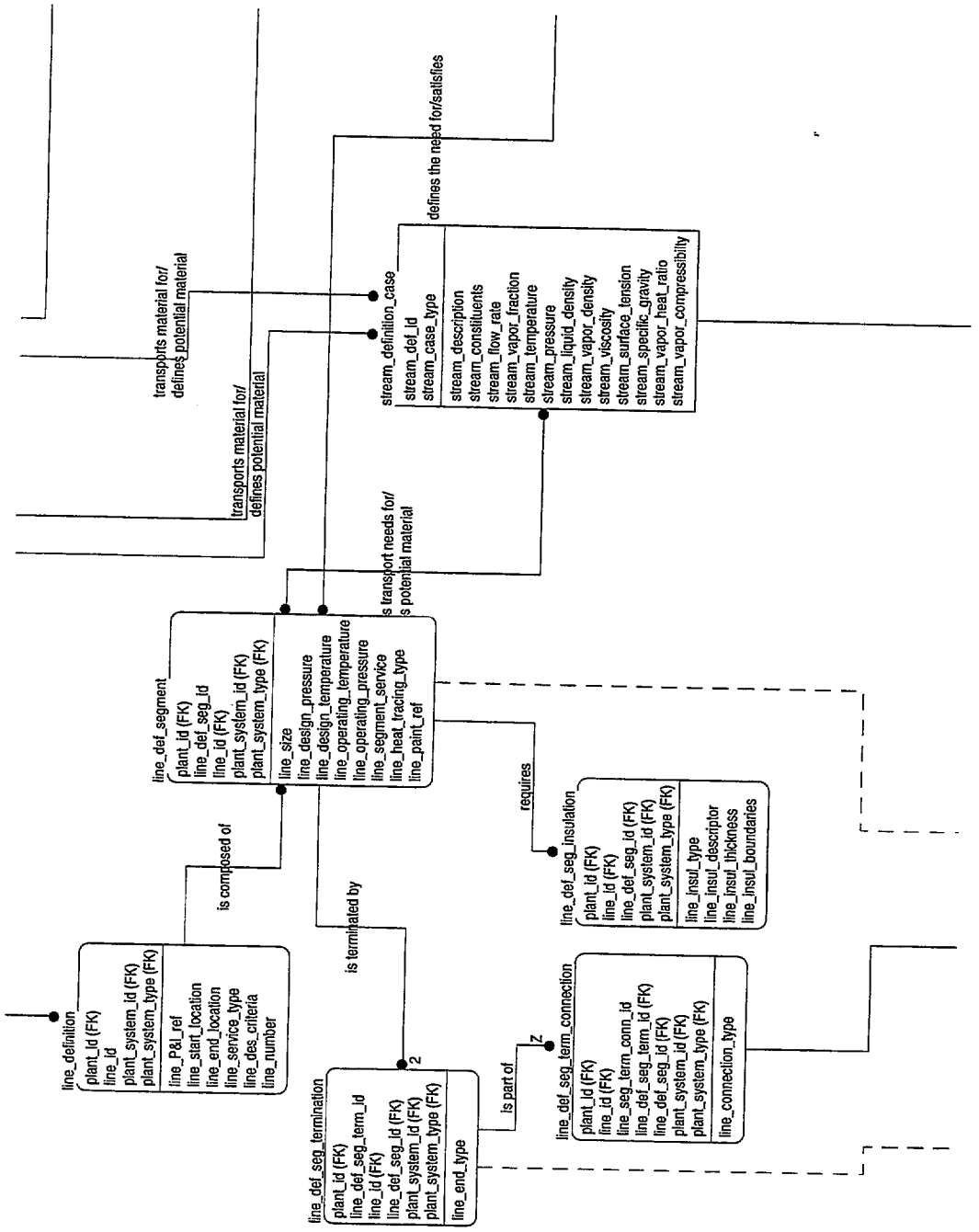

Figure G.9 - ARM View 1, diagram 9 of 19 in IDEF1X

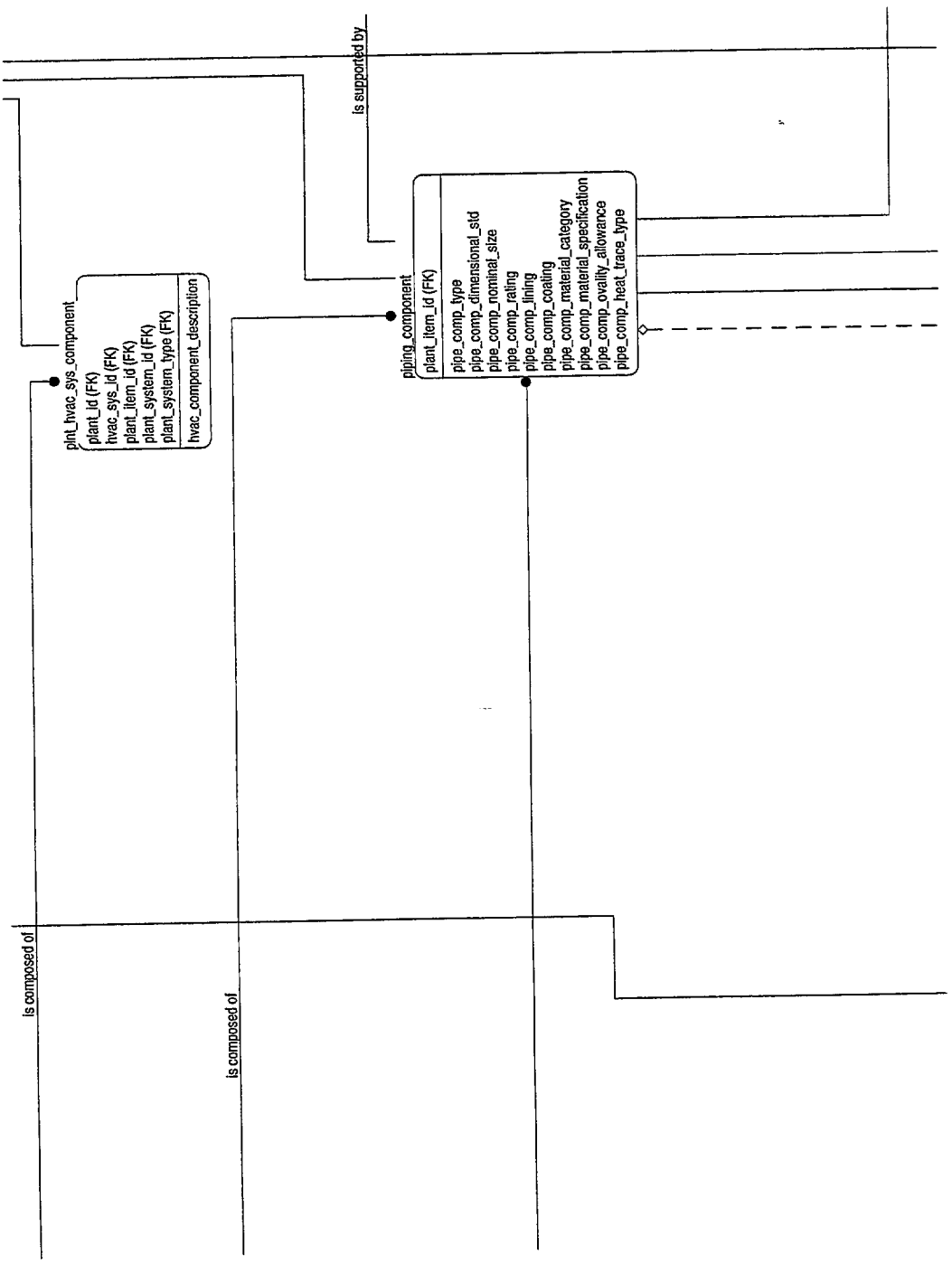

Figure G.10 - ARM View 1, diagram 10 of 19 in IDEF1X

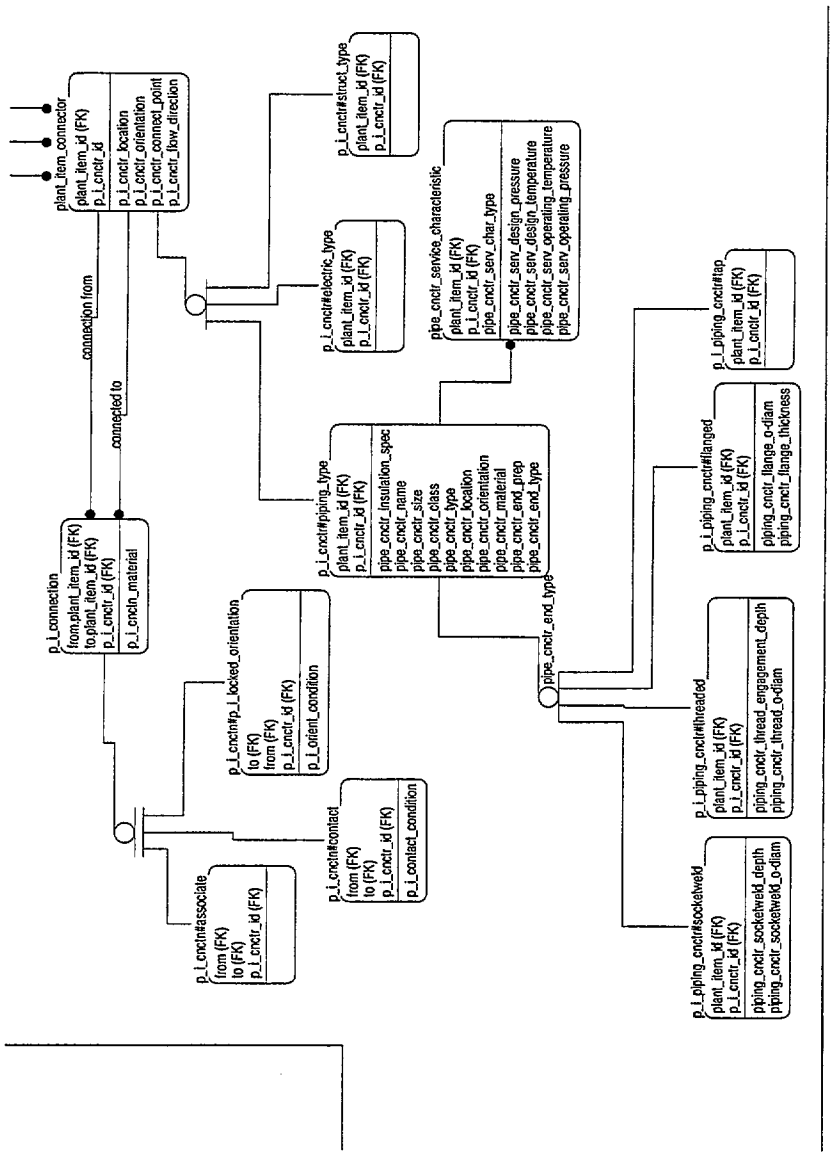

Figure G.11 - ARM View 1, diagram 11 of 19 in IDEF1X

Figure G.12 - ARM View 1, diagram 12 of 19 in IDEF1X

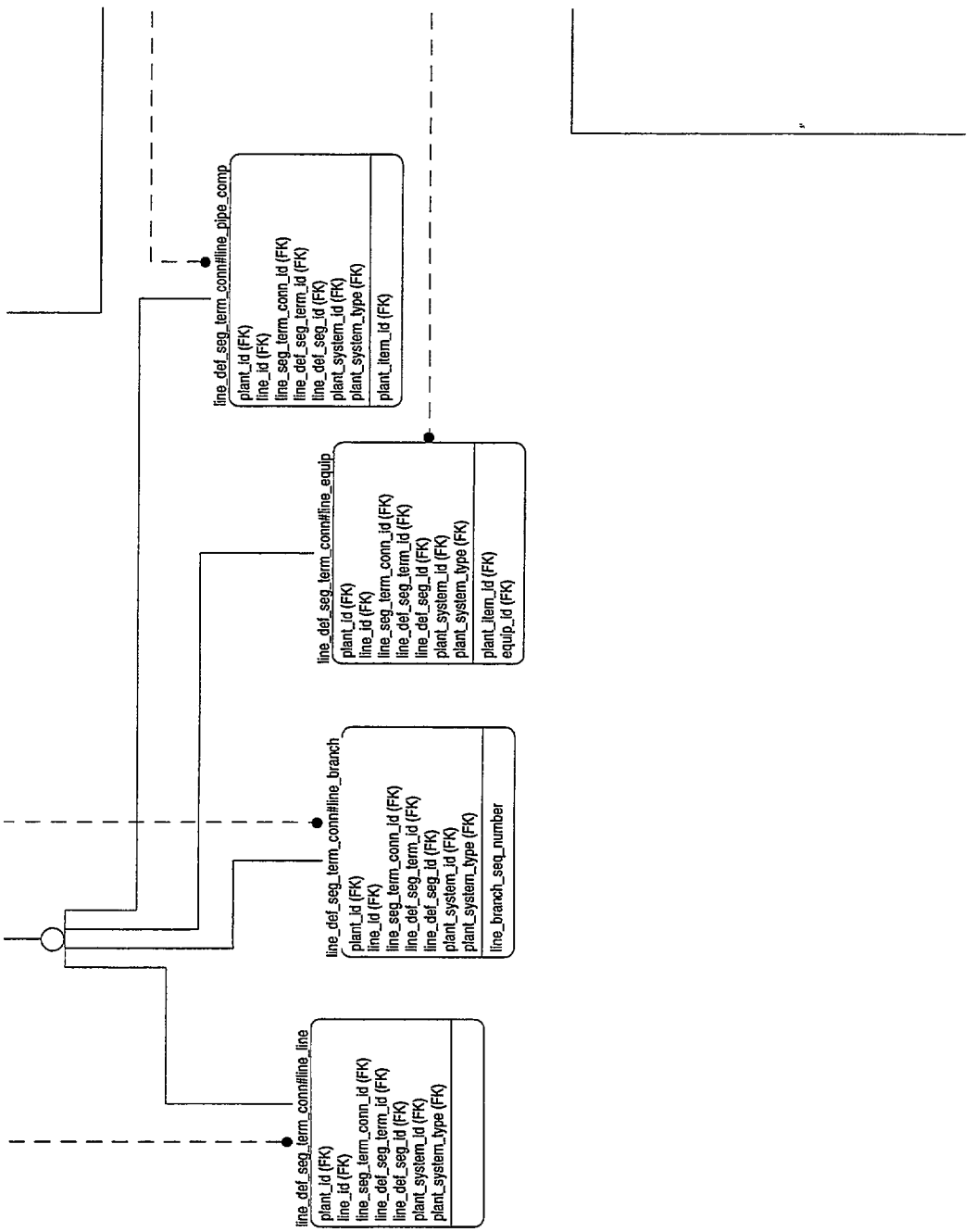

Figure G.13 - ARM View 1, diagram 13 of 19 in IDEF1X

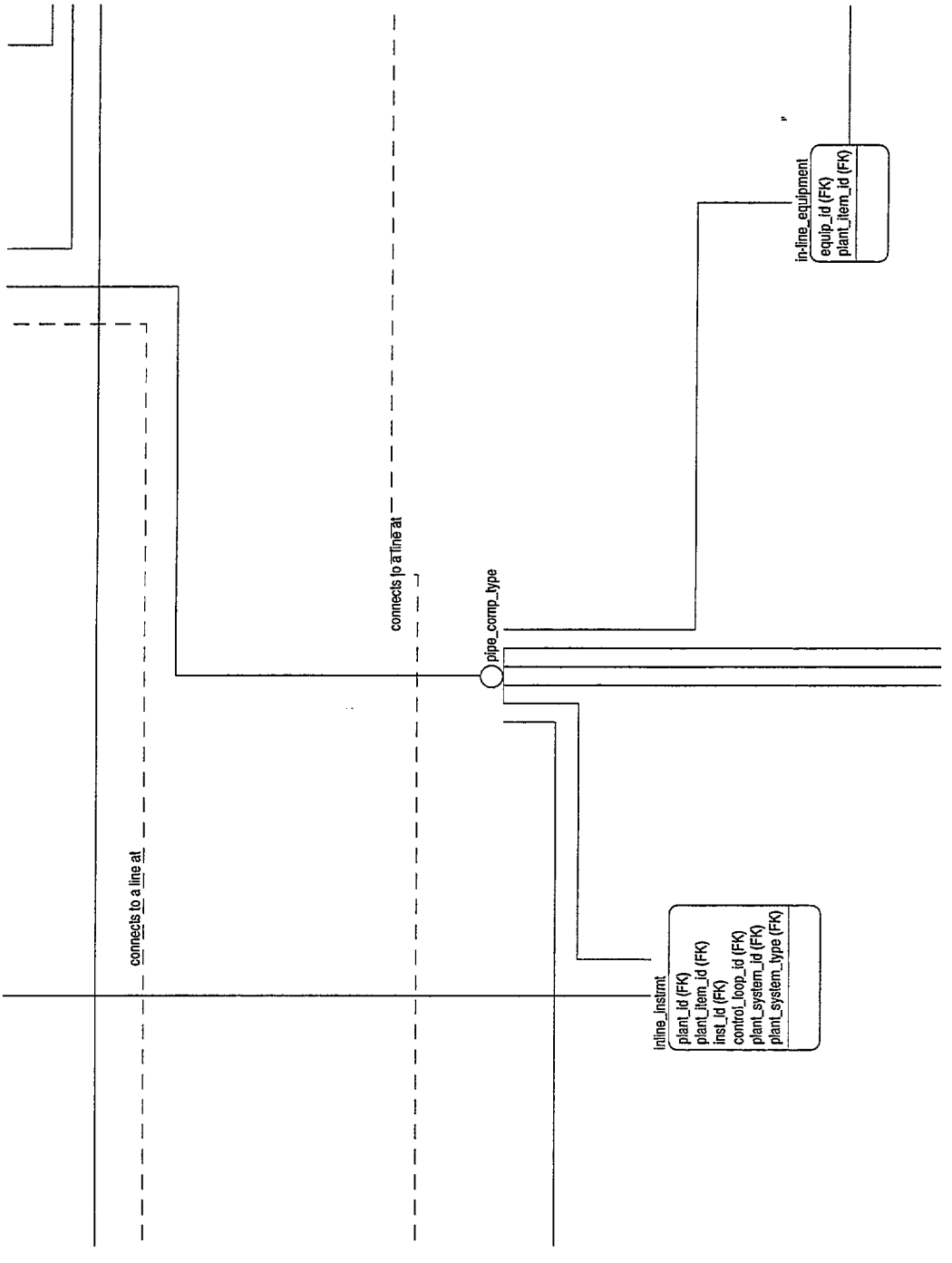

Figure G.14 - ARM View 1, diagram 14 of 19 in IDEF1X

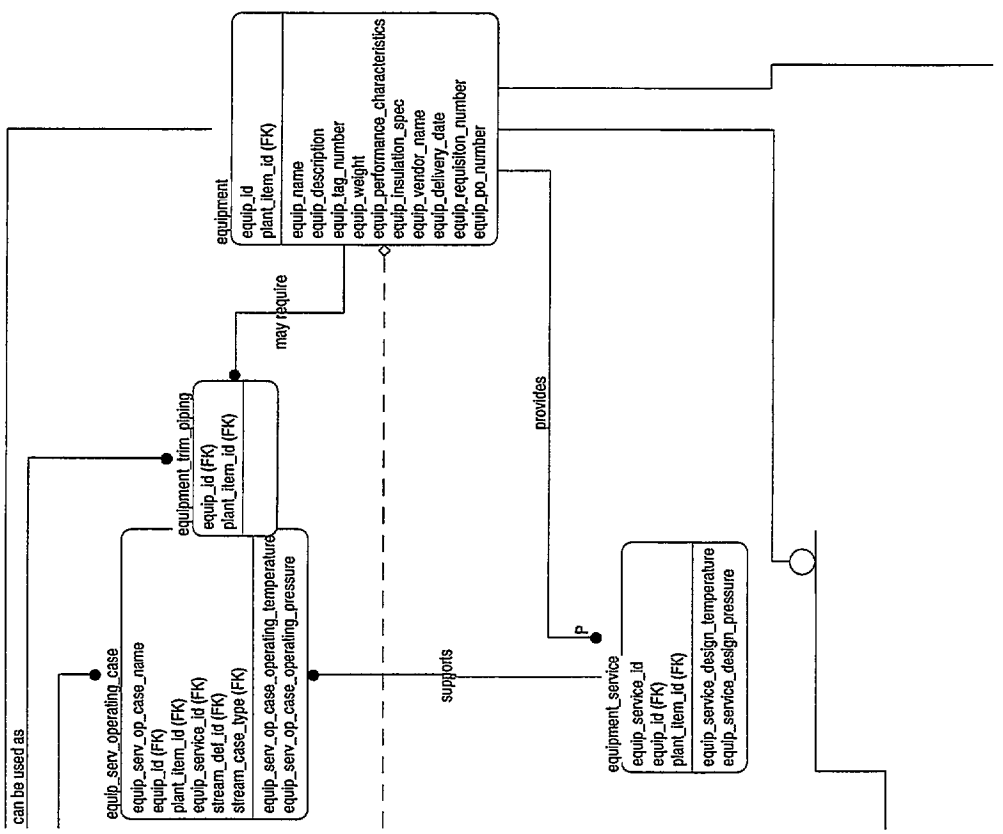

Figure G.15 - ARM View 1, diagram 15 of 19 in IDEF1X

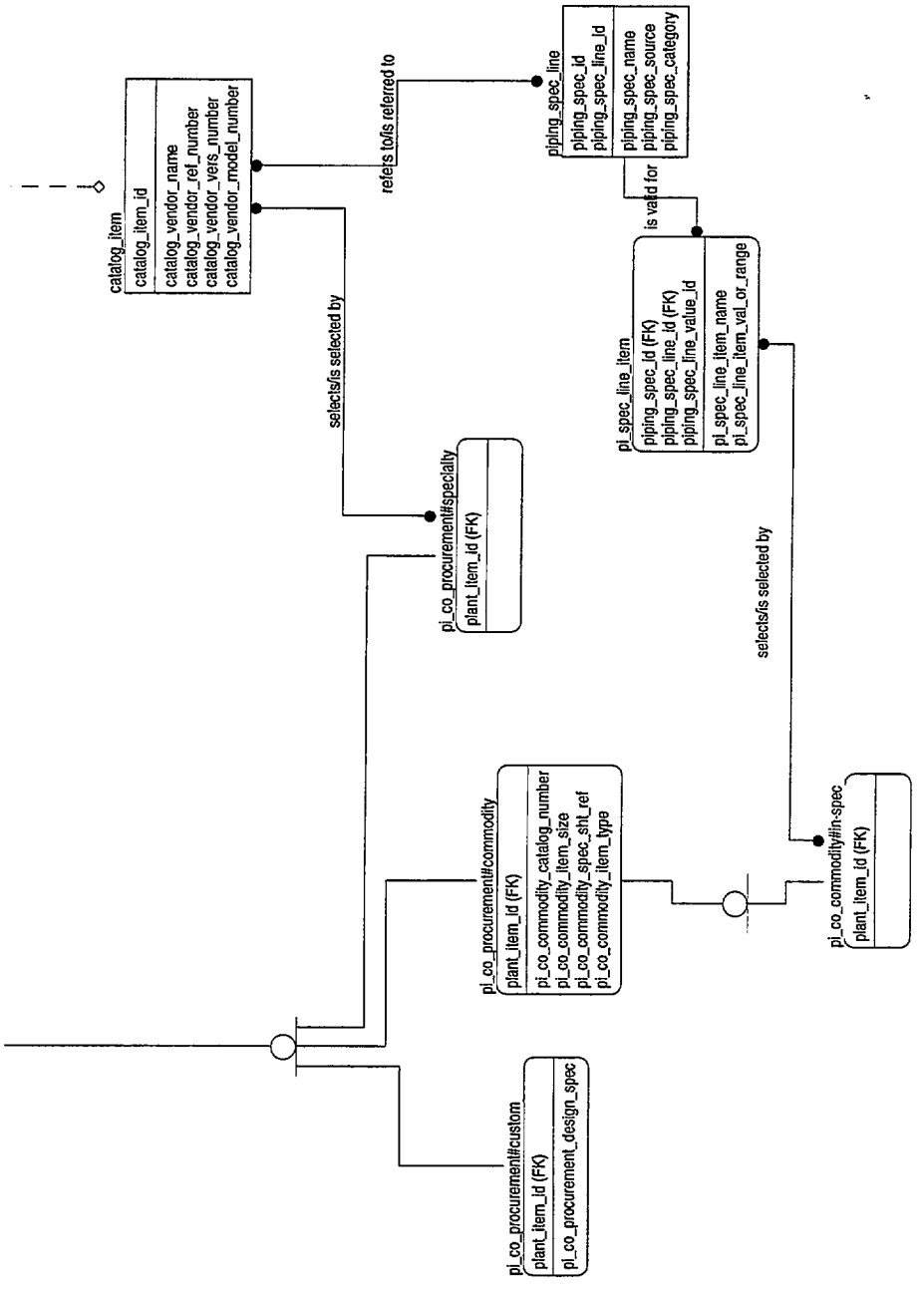

Figure G.16 - ARM View 1, diagram 16 of 19 in IDEF1X

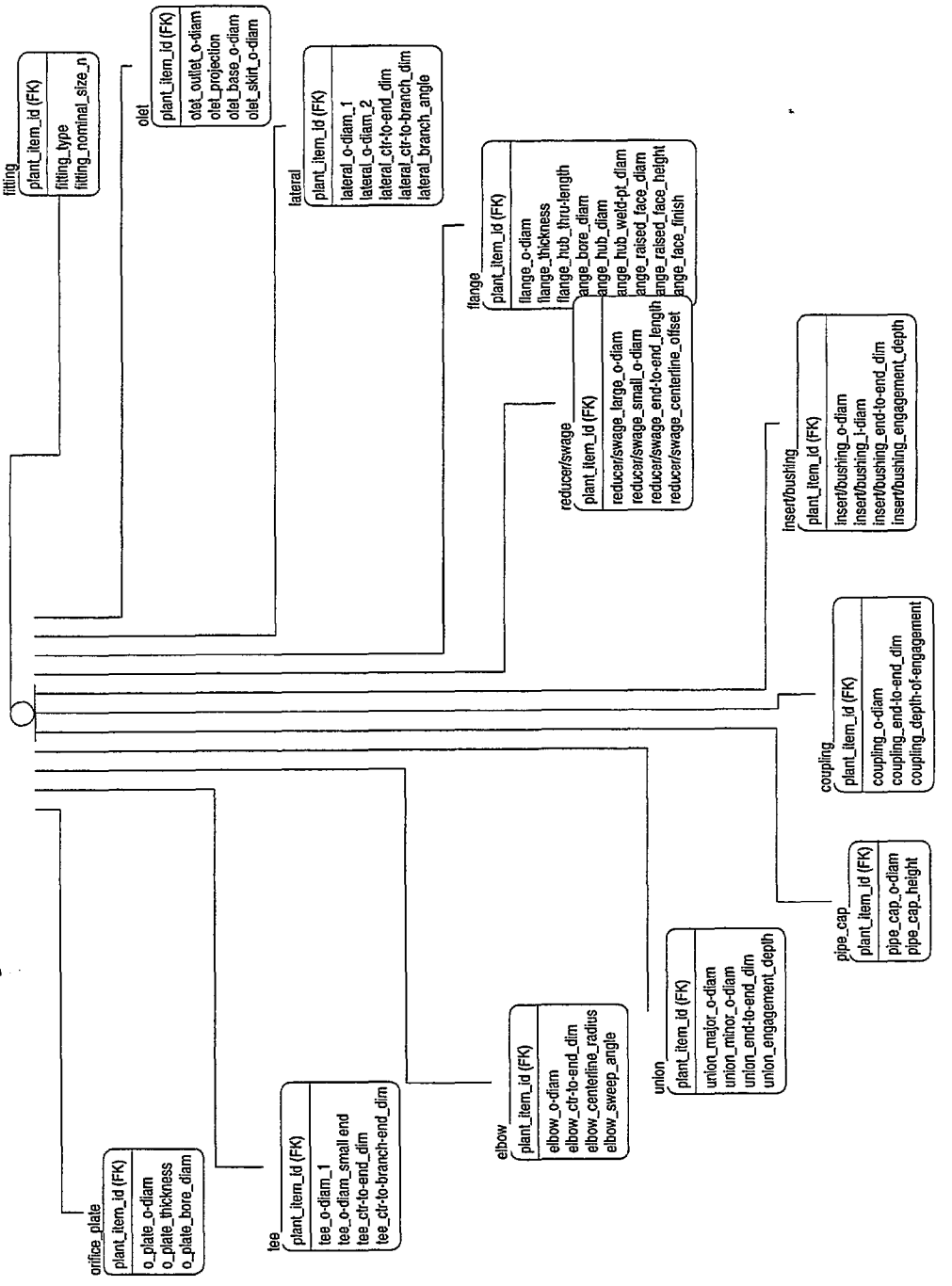

Figure G.17 - ARM View 1, diagram 17 of 19 in IDEF1X

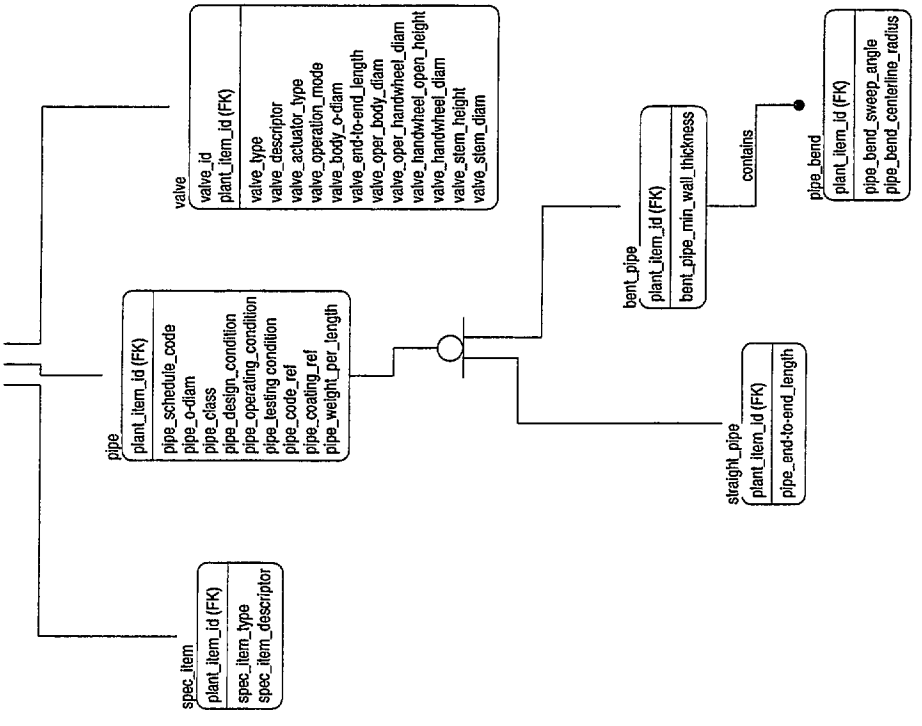

Figure G.18 - ARM View 1, diagram 18 of 19 in IDEF1X

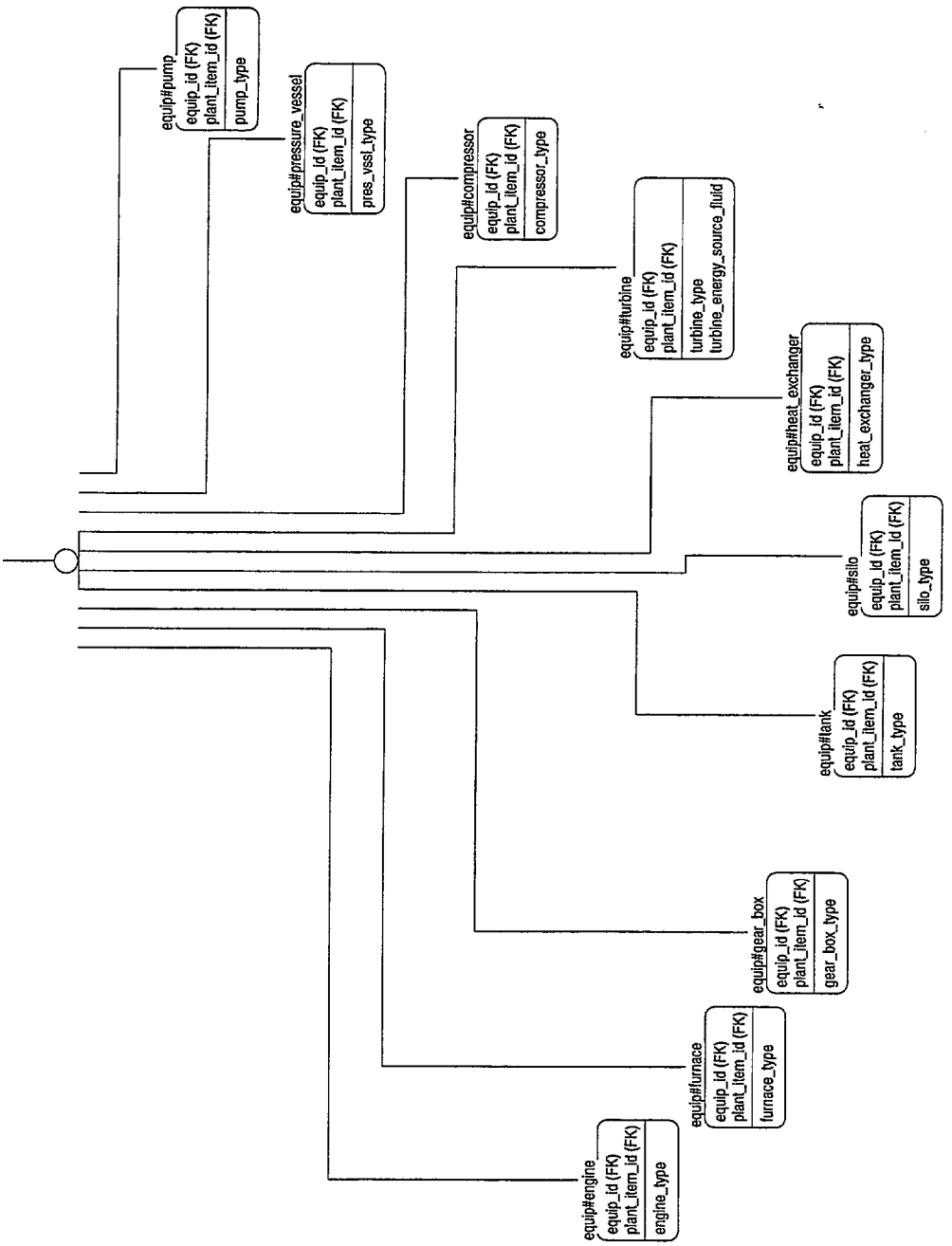

Figure G.19 - ARM View 1, diagram 19 of 19 in IDEF1X

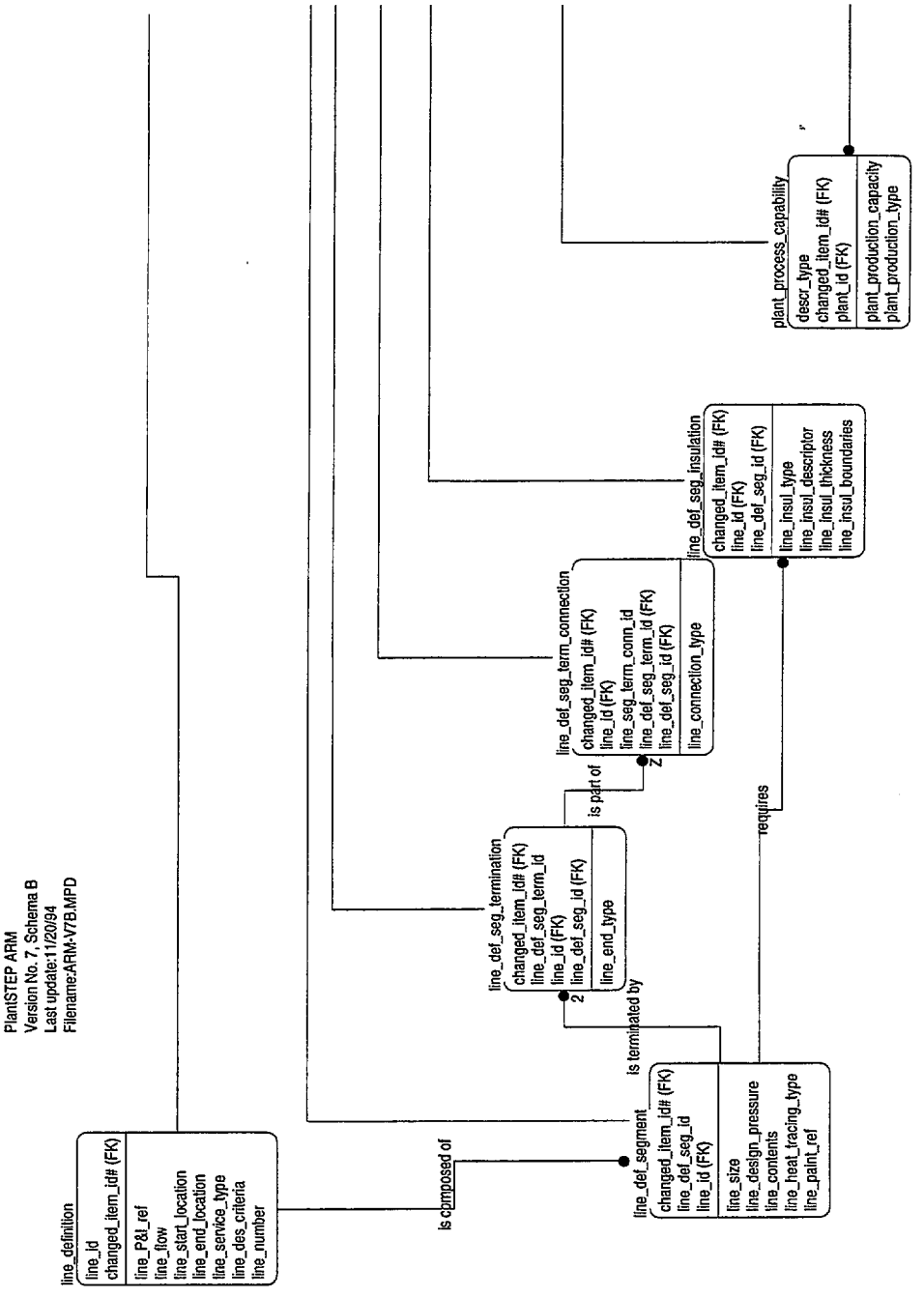

Figure G.20 - ARM View 2, diagram 1 of 4 in IDEF1X

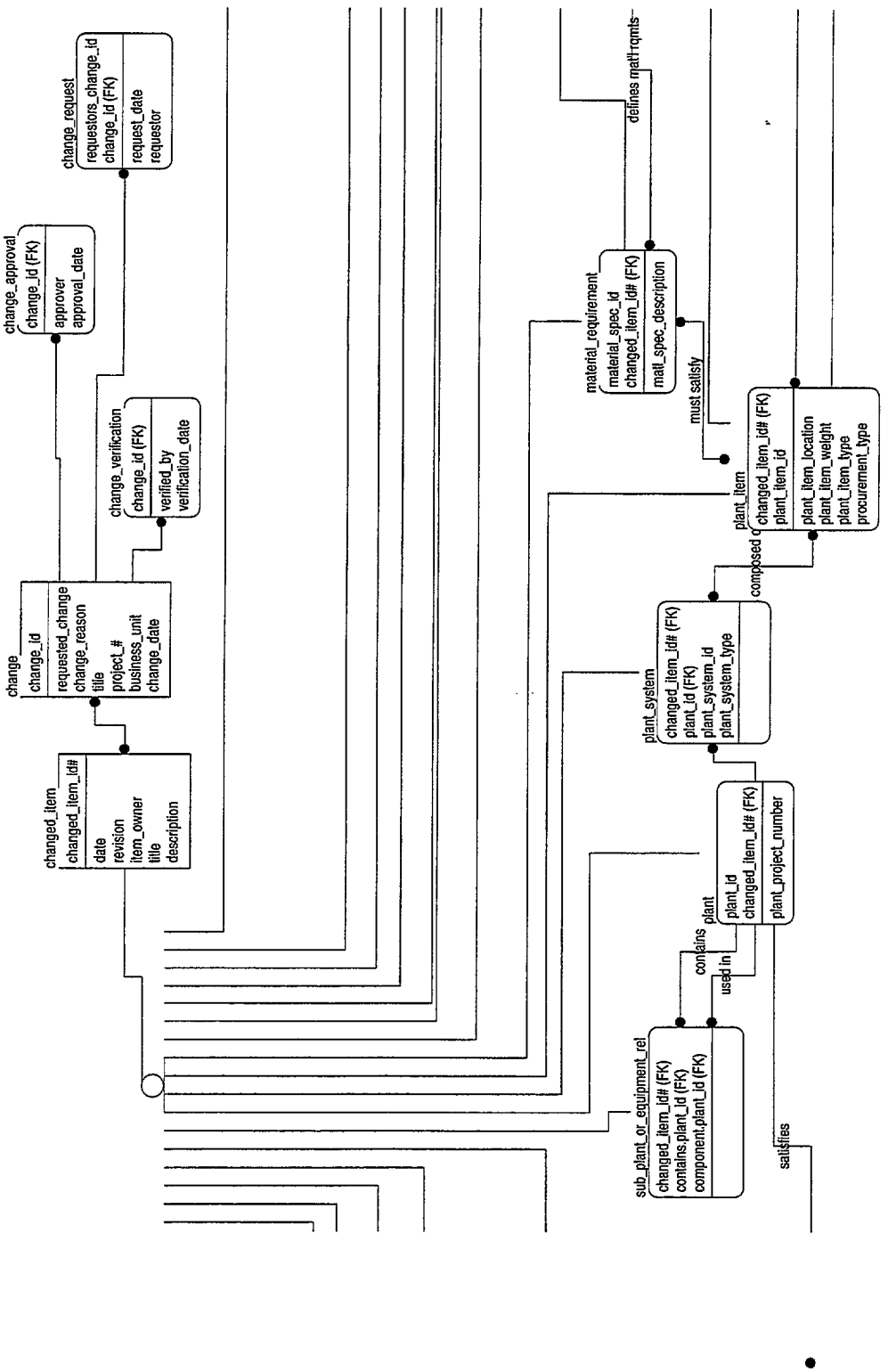

Figure G.21 - ARM View 2, diagram 2 of 4 in IDEF1X

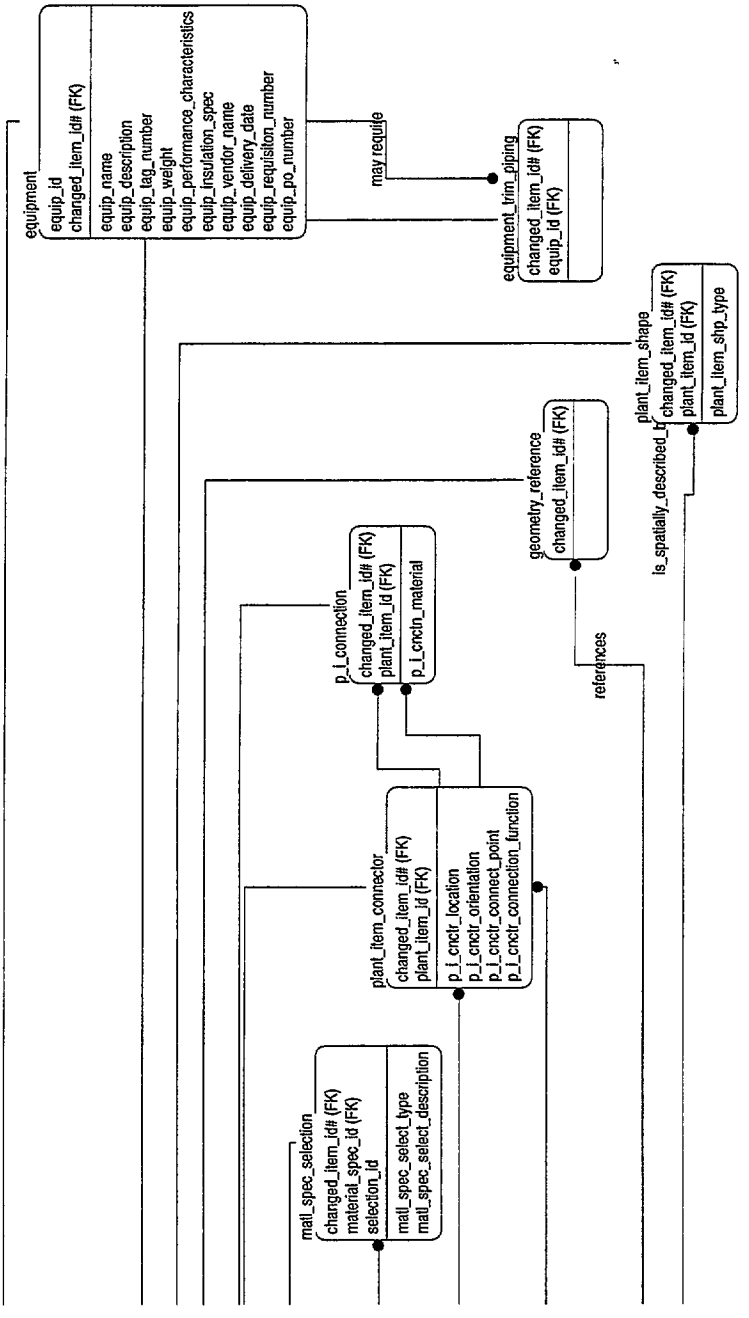

Figure G.22 - ARM View 2, diagram 3 of 4 in IDEF1X

Figure G.23 - ARM View 2, diagram 4 of 4 in IDEF1X

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