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Information Model for On-Site Inspection System

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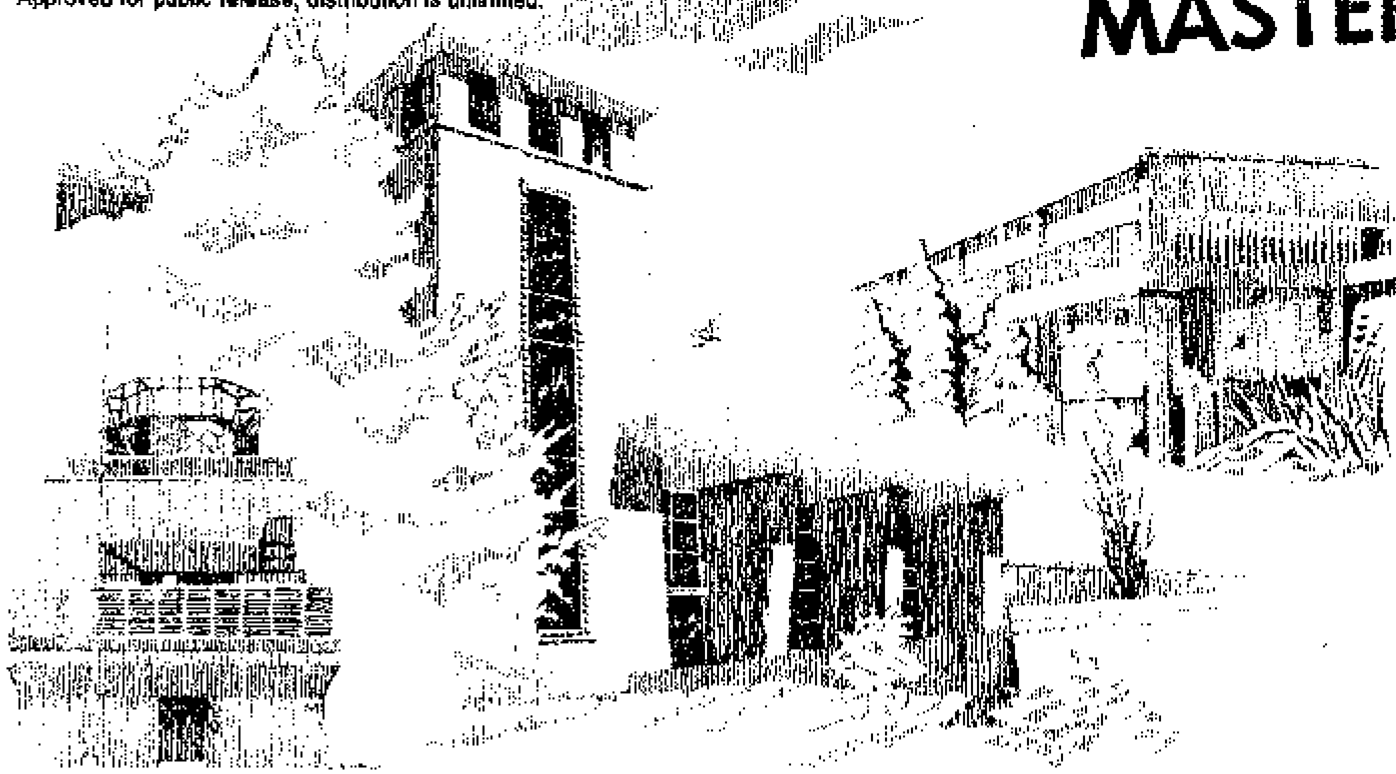

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Date: February 1, 1997

To: Distribution

From: Olin Bray, 4524

Subject: Final Report for FY93 LDRD
Information Integration for Data Fusion

The attached report is one of three reports that resulted from work done under the FY93 LDRD, *Information Integration for Data Fusion*. Copies are being sent to people who were involved in the project or who might be interested in its results. If you know of other people who would be interested in copies of these reports, please have them contact me or let me know and I will send them a copy.

Purpose of this LDRD:

Data fusion is the integration and analysis of data from multiple sensors to develop a more accurate understanding of a situation and determine how to respond to it. It can be applied in many application areas, several of which were explored in this LDRD project.

The *Information Integration for Data Fusion* LDRD project had two purposes: (1) to see if a natural language-based information modeling methodology could be used for data fusion problems, and if so, (2) to determine whether this methodology would help identify commonalities across areas and achieve greater synergy. Both of these hypotheses were confirmed. The project found five common objects that are the basis for all of the data fusion areas examined: targets, behaviors, environments, signatures, and sensors. Many of the specific facts related to these objects were common across several models and could easily be reused. In some cases, even the terminology remained the same. In other cases, different areas had their own terminology (e.g., a target in defense, a workpiece or machine tool in manufacturing, or an organ for health care), but the concepts were the same. This commonality is important with the growing use of multisensor data fusion. Data fusion is much more difficult if each type of sensor uses its own objects and models rather than building on a common set. Information model integration at the conceptual level is much easier than at the implementation level.

Report 1:

The first report, *Information Integration for Data Fusion* (SAND97-0195) provides a framework for considering data fusion from an information integration perspective, discusses how the synergy generated by this LDRD would have benefited an earlier successful project and contains a summary information model from that project, describes a preliminary truce management information model, and explains how information integration can facilitate cross-treaty synergy for various arms control treaties.

Report 2:

The second report, *Information Model for On-Site Inspection System* (SAND97-0049), describes the information model that was jointly developed as part of two LDRDs: (1) *Information Integration for Data Fusion*, and (2) *Interactive On-Site Inspection System: An Information System to Support Arms Control Inspections.* Section 1 describes the purpose and scope of the two LDRD projects and reviews the prototype development approach, including the use of a GIS. Section 2 describes the information modeling methodology. Section 3 provides a conceptual data dictionary for the OSIS (On-Site Inspection System) model, which can be used in conjunction with the detailed information model provided in the Appendix. Section 4 discussions the lessons learned from the modeling and the prototype. Section 5 identifies the next steps — two alternate paths for future development. The long-term purpose of the On-Site Inspection LDRD was to show the benefits of an information system to support a wide range of on-site inspection activities for both offensive and defensive inspections. The database structure and the information system would support inspection activities under nuclear, chemical, biological, and conventional arms control treaties. This would allow a common database to be shared for all types of inspections, providing much greater cross-treaty synergy. The details of the prototype are described in another Sandia report (SAND93-2300), *Interactive On-Site Inspection System: An Information System to Support Arms Control Inspections.*

Report 3:

The third report, *Data Fusion for Adaptive Control in Manufacturing: Impact on Engineering Information Models* (SAND97-0048), consists of four parts: Section 1 defines data fusion and explains its impact on manufacturing. Section 2 describes an information system architecture and explains the natural language-based information modeling methodology used by this research project. Section 3 identifies the major design and manufacturing functions, reviews the information models required to support them, and then shows how these models must be extended to support data fusion. Section 4 discusses the future directions of this work.

Outside Exposure:

This LDRD work also had exposure outside of Sandia. The first report provided the basis for a presentation, *Information Modeling Framework for Data Fusion Problems,* at the New Mexico DECUS Conference in Albuquerque, NM, in May of 1993. Part of the first report also provided the basis for a panel discussion at the DOE Expo 93 on Intelligence and Special Operations in Oak Ridge, TN. The third report was the basis for a paper, *Data Fusion for Adaptive Control in Manufacturing: Impact on Engineering Information Models,* for the ASME Engineering Information Management Symposium in San Diego in August 1993, which was reprinted in the ASME journal *Computers in Engineering.*

The work that resulted in the second report *(Information Model for On-Site Inspection System)* was done in conjunction with another LDRD that actually developed a prototype system based on the model, which was subsequently demonstrated to IAEA and other agencies. This system is now being shown at the Cooperative Monitoring Center.

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Information Model for On-Site Inspection System

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Abstract

This report describes the information model that was jointly developed as part of two FY93 LDRDs: (1) Information Integration for Data Fusion, and (2) Interactive On-Site Inspection System: An Information System to Support Arms Control Inspections. This report describes the purpose and scope of the two LDRD projects and reviews the prototype development approach, including the use of a GIS. Section 2 describes the information modeling methodology. Section 3 provides a conceptual data dictionary for the OSIS (On-Site Inspection System) model, which can be used in conjunction with the detailed information model provided in the Appendix. Section 4 discussions the lessons learned from the modeling and the prototype. Section 5 identifies the next steps — two alternate paths for future development. The long-term purpose of the On-Site Inspection LDRD was to show the benefits of an information system to support a wide range of on-site inspection activities for both offensive and defensive inspections. The database structure and the information system would

(Abstract continued to page ii)

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support inspection activities under nuclear, chemical, biological, and conventional arms control treaties. This would allow a common database to be shared for all types of inspections, providing much greater cross-treaty synergy. The details of the prototype are described in another Sandia report (SAND93-2300), *Interactive On-Site Inspection System: An Information System to Support Arms Control Inspections.* The Information Integration for Data Fusion LDRD project had two purposes: (1) to see if a natural language-based information modeling methodology could be used for data fusion problems, and if so, (2) to determine whether this methodology would help identify commonalities across areas and achieve greater synergy. Both of these hypotheses were confirmed. The project found five common objects that are the basis for all of the data fusion areas examined: targets, behaviors, environments, signatures, and sensors. Many of the specific facts related to these objects were common across several models and could easily be reused. In some cases, even the terminology remained the same. In other cases, different areas had their own terminology, but the concepts were the same. This commonality is important with the growing use of multisensor data fusion. Data fusion is much more difficult if each type of sensor uses its own objects and models rather than building on a common set. Information model integration at the conceptual level is much easier than at the implementation level. Another Sandia report (SAND97-0195), *Information Integration for Data Fusion*, provides a more detailed data fusion framework and addresses this commonality more specifically.

Contents

Figure

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Information Model for On-Site Inspection System

Introduction

This report summarizes the joint work done by two LDRDs (Laboratory-Directed Research and Development) in their area of overlap. For more details on each LDRD, see their separate reports (SAND97-0195, *Information Integration for Data Fusion,* and SAND93-2300, *Interactive On-Site Inspection System: An Information System to Support Arms Control Inspections*).

This report explains the purpose of each of the two LDRDs, describes the approach, summarizes the methodology, describes the information model in some detail, summarizes the lessons learned, and identifies the next steps.

Purpose and Scope of On-site Inspection LDRD

The work related to this LDRD has both a long-term and a short-term purpose, with the LDRD work focused on the short-term. The long-term purpose was to show the benefits for an information system to support a wide range of on-site inspection activities for many arms control treaties. These activities include planning, conducting, and analyzing the results for both defensive and offensive inspections.

- A **defensive inspection** is one in which your facility is the target of the inspection. In this context, the system should help determine what is and is not covered by the inspection, where the inspectors go, what they see, and what they can infer from this inspection (and perhaps previous inspections of this or other similar sites).
- An **offensive inspection** is one in which your inspection team is inspecting someone else's site. In this context, the system should identify legitimate items that can be present at the site, treaty-limited items (and their quantities) that are suspected or found at the site, and evidence to look for to infer the presence of treaty-limited items or behaviors. A sophisticated real time system could even suggest what types of evidence to look for, given the evidence that had already been found, i.e., customizing an inspection while it is occurring.

The ideal information system would support inspection activities under nuclear, chemical, biological, and conventional arms control treaties. In most cases, the structure of the database would be the same for the different types of treaties; only the actual data values would be different. This would allow a common database to be shared for all types of inspections, providing much greater cross-treaty synergy. This could allow us to make inferences based on any inspection information, not just data from the current inspection or the current type, e.g., nuclear or chemical.

Obviously, the development of such as system is far beyond the scope of this LDRD. Therefore, the LDRD work focused on a short-term deliverable: a prototype information system to demonstrate the type of capabilities and functions envisioned for the complete system. The scope of this prototype was constrained so that it could be done within the LDRD time frame; but it would provide enough substance for members of the arms control and inspection community to evaluate both the demonstration system and the concept and make recommendations for future directions. These demonstrations have generated interest among a number of potential users.

Purpose and Scope of Data Fusion LDRD

The purpose of this LDRD was to explore the value of information modeling for data fusion. The project investigated the application of natural language-based information modeling for a variety of data fusion areas, including defense, arms control, and manufacturing. It identified a set of objects (targets, behaviors, environments, signatures, and sensors) that are common to all of the examined data fusion areas. It also developed initial high-level information models for several areas and identified their commonality. Information models developed or revisited as part of this LDRD include truce management, Synthetic Aperture Radar (SAR, revisited), arms control, on-site inspections, and adaptive control for manufacturing.

Information modeling uses a natural language, fact-based approach to explicitly model the information requirements for an application area or to integrate a set of application areas. It has been used for requirements definition and for the development of information systems in a variety of areas, but until now was not used in the data fusion area. This LDRD work showed the value of this approach for defining and designing information systems to support data fusion efforts in a wide range of areas.

Although data fusion is a rapidly growing area, there is little synergy and use of common, reusable, and/or tailorable objects and models, especially across different disciplines, e.g., defense and manufacturing. The project had two purposes: (1) to see if a natural language-based information modeling methodology could be used for data fusion problems and if so, (2) to determine whether this methodology would help identify commonalities across areas and achieve greater synergy.

The project developed or refined preliminary information models for five areas — truce management, SAR, On-Site Inspections, arms control synergy, and adaptive control for manufacturing — and looked for commonality across the models. The project found five common objects that are the basis for all of the data fusion areas examined. These common objects are targets, behaviors, environments, signatures, and sensors. Many of the specific facts related to these objects were common across several models and could easily be reused. In some cases, even the terminology remained the same. In other cases, different areas had their own terminology, but the concepts were the same. For example, the terms "targets" and "signatures" are not common in manufacturing and health care; but many of the facts are the same, so the information models are easily reusable.

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1. Development Approach

There were three major aspects in the development of the On-Site Inspection System (OSIS) prototype:

(1) Development of the information model to support the requirements for various types of inspections.

(2) Learning the capabilities and uses of GIS (Geographic Information Systems).

(3) Development of a working prototype — based on the information model, a traditional DBMS (database management system), and a GIS — for a limited subset of the inspection requirements to see how all of these capabilities fit together.

Information Requirements and Model

Initially, there were some very general information requirements that were needed to support on-site inspections. The initial flavor of the questions were as follows: Who went on which inspections? What did they see? Where? When? Over time these questions were clarified and more clearly focused, especially once the information model was developed enough to show precisely the type of data that was needed. The following is a sample of the more detailed list of questions:

- Who were the inspectors/escorts on inspection X?
- What did they see (stops, equipment, processes)?
- What are the skills and background of inspector X?
- Were any inspectors common to inspections X, Y, and Z (same or different treaties)?
- Which OOVs (Objects of Verification) were inspected by inspector X?
- Which sites were visited under inspection declaration X?
- Under an inspection of OOV unit X, which sites can be inspected?
- Under inspection declaration X, which OOVs and sites should be alerted?
- Given treaty clause X, list anomalies, inspections, OOVs, sites, inspectors.

- What equipment was seen by inspector X in the last N months (stops, equipment, processes)?

- List sites and/or OOVs and the number of inspections in the last year.

- Which OOVs have been inspected by teams with skills X, Y, and Z? Where were the inspectors on the team employed?

- On inspection X, list all of the stops where there was a mismatch between the skills of the inspectors and the escorts.

- For inspection declaration X, list all articles published by the inspectors.

- For the sites/OOVs, list all of the processes/equipment related to articles.

- Have any workers at site X been to a conference with an inspector? Which conference?

The initial information modeling effort was broad enough to include requirements for several different types of treaties, specifically CFE (Conventional Forces in Europe) and CWC (Chemical Warfare Convention), and for both a defensive and offensive mode. The initial information model covered most of the factors common across many different types of treaties. This version of the information model helped us to precisely understand the problem and its requirements.

Examples of the necessary concepts include treaty, treaty clause, inspection, inspector, escort, site, treaty-limited item, and inspection declaration. At this point, the model also included many of the factors unique to different types of treaties. In some cases, these factors were added to the model without affecting other parts of the existing model, while in other cases the different concepts could be generalized into a common concept that applied across treaties. This information model is one of the few (and the only one we are aware of) that takes a broad cross-treaty approach and can capture inspection and site data in a single database for all of the various arms control treaties.

Once the initial information model was developed, a version of it was scoped down to the more limited requirements for the prototype. The prototype was focused on only a defensive inspection under the CWC. This scoping down primarily eliminated concepts. It did not change the structure of the model, so most of what was done with the prototype would also be applicable to the original model. (In a few cases, additional real world complexity has not yet been included in either the main or the prototype model. For example, neither model currently addresses the issue that a person — an inspector, an escort, or an observer — can have dual citizenship. However, once this structure is defined, it can be easily added to both information models.)

Geographic Information System (GIS)

A GIS is a software application that can relate spatial information (e.g., maps and floor plans) to other information, particularly data stored in relational databases. The GIS used for the PC prototype was ArcCAD, which is really a GIS front end built on dBase, a commercial database management system. The actual production system may be done on a workstation using ArcInfo and ORACLE.

The requirements for, and use of, the GIS integrated very well with the natural language-based information modeling approach. For example, the information model would specify the types of facts about a machine tool, e.g., its serial number, type, manufacturer, maintenance schedule, size, and location. The size and location would be the data needed by the GIS to either display the machine tool and any data about it or identify which machine tool was selected when someone pointed to a location on the screen. The information model for the database did not need to be changed because the database was front-ended by and linked to a GIS.

The actual experience with the GIS was that finding and loading the volume of data required was as difficult, or more difficult, than the actual implementation.

Prototype

The purpose of the prototype was to show the concept and some of the functionality for an information system to support on-site inspections.

Given the time and resource constraints, the scope of the prototype was limited to support planning for a defensive inspection under the CWC. Therefore, a subset of the broader information model and database design was used for the prototype. Also the prototype was implemented on a different hardware and software platform than would be used for a more complete production system.

Currently, a prototype OSIS has been implemented on a PC laptop using information from Sandia's Tech Area 1 and Buildings 805 and 890.

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2. Information Modeling

This section briefly describes the information modeling methodology, a natural language-based, fact-based method called NIAM (Nijssen Information Analysis Methodology). This report describes only the main parts of the methodology and how it is used.

Information Modeling Methodology

This section provides an introduction to the concepts used in natural language-based information modeling. The information model can be represented in either of two ways — verbally or graphically.

- The **verbal representation** can be read, critiqued, and corrected by anyone who knows the subject matter, with virtually no explanation of the methodology.

- The **graphical representation** shows the relationships among the entity types more clearly and concisely, but it does require a few minutes of explanation to be understood. After reading this section, a person should be able to read and understand, although not construct, most of a graphical representation of an information model.

Concepts Covered in this Section:

- sentence
- elementary sentence
- fact
    - fact type
    - fact instance
- entity
    - entity type
    - entity instance
- label type
- role/verb
- constraints
    - total
    - uniqueness

Verbal Representation of Information Model

A **sentence** is simply a natural language statement by a user describing some aspect of the problem area. It may be simple, describing a specific example or instance — "Part X weighs 10 pounds," — or complex — "Part X, which was designed by John Smith last year, now sells for $100 and comes in red, green, and blue."

Any complex sentence can be decomposed into **elementary sentences**: "Part X was designed by John Smith." "Part X was designed in 1994." "Part X in 1995 sells for $100." Note that in this case, an elementary sentence is not binary: "Part X in 1995" does not provide the price. "Part X sells for $100" does not specify when, but the price may change over time. The other binary alternative — "1995 sells for $100" — has even more problems. The above sentences were all examples of specific instances, but they could equally well have been done in terms of types: "A part is designed by an engineer." "A part sells for a price in a year." "A part has a color."

The initial problem statement from the user is often a narrative consisting of simple and complex sentences referring to both types and instances. The information modeling methodology provides a way to decompose the problem statement into elementary sentences and formally model them to unambiguously identify all of the relationships and constraints in a way that the user can review them to verify or correct them.

The user describes the problem in natural language sentences: some are already elementary sentences while others are complex sentences. The complex sentences are decomposed into the corresponding elementary sentences. Many elementary sentences are binary, but they do not have to be. The key criterion is that an elementary sentence cannot be decomposed into more basic sentences without losing information, as shown in the previous part, date, and price example.

A structured sentence, sometimes called a **fact**, has a very specific form. It consists of two **entity types** (such as person, part, or department) that are related by a **role**, usually a **verb phrase** (such as designs, works in, or is responsible for). Examples of fact types include the following:

- A person designs a part.
- A person works in a department.
- A department employs a person (the inverse of the previous fact).

For each fact type there can be many **fact instances**, such as "Bill designed part 1234," or "Sam works in Engineering."

To completely capture all of the required information, a deep structure sentence or fact has a specific form. It specifies the first entity type, its identifier or **label type, several examples or instances** of that label type, a verb phrase, and another entity's set of information (i.e., entity type, label type, and label instance). Although label instances are sometimes called examples (in the sense that they are examples of entity types), the information modeling methodology really requires examples of facts or fact instances.

Entity type:

Person

Label type:

SSN

Label instance:

123-45-6789

Verb:

works in

Entity type:

Department

Label type:

Department name

Label instance:

Engineering

Fact instances or examples are critical because they explicitly define the data constraints, which the DBMS must enforce. Let's explain the **constraint types** using specific examples for the fact pair: "A person designs a part" and "A part is designed by a person."

The **total constraint** tells whether or not every entity instance of a specific type must participate in the fact type. Must every person design a part? No, so the first fact/role is not total. However, must every part be designed by a person? If we assume the answer is yes, then this fact/role is total. If we know anything about a part instance, we must know the person who designed it. (Database experts will recognize that this is a mandatory attribute for an entity; but the user has remained insulated from that designer view.)

In an actual modeling session, someone may raise the issue that we buy some parts from suppliers and for those parts the designer is unknown and probably irrelevant. In other words, for some parts, one set of facts apply, while for other parts, a different set of facts may apply, although all parts share a common set of facts. This distinction defines the subtype-supertype relationship. The supertype (part) has a set of facts that are common to all of the subtypes (designed part and purchased part). The subtypes are distinguished from each other by the unique set of facts that apply to each subtype. All of the common facts (except the identifier) are removed from the subtypes and are associated with the supertype.

To determine another important constraint — the **uniqueness constraint** — requires an additional example. Consider the following examples for the fact "a person works in a department."

	Person	Department
1.	Sam	Eng
2.	Mary	Mfg
3.	Bill	Eng
4.	Sam	Finance
5.	Joe	—
6.	—	Accounting

When shown the previous six examples, the user can quickly determine which ones are good:

- Examples 1 and 2 are good because there is no overlap; they are two independent fact instances.
- Example 3 is good because a department (Eng) can have more than one person in it.
- Example 4 is incorrect, however, because a person (Sam) can only be in one department. This defines a uniqueness constraint, an specific instance of a person can only appear once in this fact type.
- Examples 5 and 6 simply document the totality constraints described above. Example 5 is incorrect because every person must be in a department, i.e., the total constraint. Example 6 simply verifies that departments may be created and other data collected about them before people are actually assigned to them. However, this is only a business rule constraint, not a physical constraint, so another company could decide that they wanted to consider example 6 as incorrect.

After analyzing these examples, a more precise statement of the facts is possible. These were the initial facts:

- A person works in a department.
- A department employs a person.

Considering the examples, the more precise facts are as follows:

- Every person must work in one department.
- A department may employ one or more people. (Note: The zero people case is implied by the "may" in this example.)

The possible uniqueness constraints are that the object on the left may be unique, the object on the right may be unique, each object may be unique, or the combination may be unique. An example of fact with the combination is "a person is assigned to a project." A person can be assigned to many projects and a project can have many people, but you would not assign Sam to project X twice.

Graphical Representation of Information Model

For completeness, the rest of this section briefly describes the graphical representation of the information model. In Figure 1, the solid circle represents an object or concept in the real world, such as a person, a department, a part, or a release status. Dashed or dotted circles represent data objects that identify or further describe real objects, such as employee name, social security number, or release code. Boxes or rectangles represent the roles played by one object type with respect to another. The two boxes together indicate that two roles are complementary — a person works in a department and a department employs a person. With appropriate naming, facts in graphic model can be read as sentences.

Figure 1 shows several basic facts (in both directions) and their constraints. The facts shown include: "a person is identified by a SSN," "a person works in a department," "a person designs a part," "a person is assigned to a project," and "a part has a current release status." (Note: The model must specify "current" release status because a part will have many release statuses over time.) The constraints are also shown. The V indicates a total constraint and the line over a role indicates uniqueness. Obviously there are additional constraint types and symbols, but this should provide the reader with a general understanding of the graphic model representation. The neutral data model that can be generated from the information model (in either its verbal or its graphical representation) can be represented in any of the traditional data modeling notations.

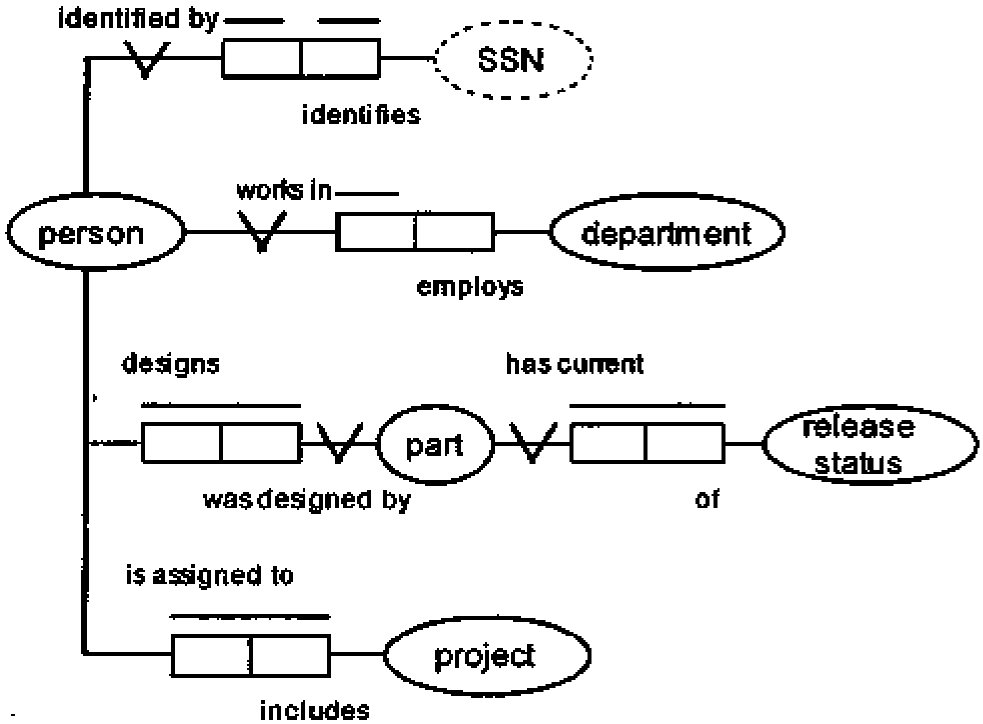

Figure 1. Example of graphic representation of information model

3. OSIS Data Dictionary

This section provides a more general definition and explanation of the major objects in the information model for On-Site Inspections, and in some cases explains why certain modeling decisions were made.

The Appendix is a copy of the output from one of the CASE tools for the methodology and is a list of the exact facts in the model. A subject matter expert can read and validate or correct these facts with virtually no knowledge of the underlying methodology. This is one of the major benefits of the approach.

The data dictionary should be used in conjunction with the facts specified in the information model for the On-Site Inspection System (see Appendix). The facts are the more precise statement of the information model. This data dictionary provides a more general description of the objects and in some cases some of the rationale for them. It is not an attempt to restate the entire information model. However, for people new to either the application area (on-site inspections and treaty verification) or information modeling, reading the data dictionary before or along with the information model can answer some questions that may arise.

This data dictionary includes the 61 major real objects. It does not provide detailed field definitions, as some data dictionaries do.

Objects Included in the Data Dictionary

- Alliance
- Analysis
- Anomaly
- Building
- Chem-analysis
- City
- Comment
- Company
- Coordinate
- Country
- Country-site
- Date

- Declaration-limit
- Document
- Equip-instance
- Equipment
- Escort
- Escort-observer
- Escort-team
- ESH-requirement (Environmental Safety and Health)
- Function
- Global-position
- Hier-equip-type
- Insp-final-report
- Inspectable-area
- Inspectable-org
- Inspection
- Inspection-declare
- Inspection-team
- Inspection-type
- Inspector
- Inspector-observer
- Itinerary
- Linear-dimension
- Location
- Mandate
- Mandate-item
- Organization
- Path-segment
- Person
- Point-of-entry

- Process
- Region
- Sample
- Site
- Site-type
- Special-facility
- Specific-tl-item
- Stop
- Stop-comment
- Technology
- Time
- TL-equipment
- TL-item (treaty-limited item)
- TL-munitions
- TL-process
- Treaty
- Treaty-clause
- Treaty-limit
- Treaty-site-desc
- Treaty-site-dgrm (treaty site diagram)

Definitions of the Objects Included in the Data Dictionary

Alliance. An alliance is a group of countries, such as NATO or the Warsaw Pact. An alliance can have many member countries and a country can belong to many alliances. Alliance is important because some treaties, for example CFE, limit items both by country and alliance.

Analysis. See chem-analysis.

Anomaly. An anomaly is a discrepancy between what an inspection team saw and what they expected to see. The expectations may be based on either specific treaty clauses or the initial presentation by the site officials of what is currently at the site.

These anomalies are documented in the final report of the inspection. (Note: There is an important distinction between an anomaly, which is what an inspection team sees and documents, and a violation, which is a political statement that implies the importance and consequences of the anomaly.)

Building. A building is a permanent structure in a site. A building has a location within a site. It also has rooms. A building has a building identifier, which is unique within a site. A building may also have alternate "identifiers," which may not be unique.

Chem-analysis. A chem-analysis is an analysis done on a sample taken during an inspection. The chemical analysis may be done on-site, at a facility located off-site but controlled by the inspected country, or by a facility located at, or controlled by, the inspecting country or organization.

City. A city may be the point-of-entry for an inspection team.

Comment. A comment is simply a general descriptive field that can be used in several areas. In some cases, there are specific types of comments, e.g., a Stop Comment, which is a comment made by an inspector at a specific location or stop on an itinerary.

Company. A company is a privately- or government-owned enterprise that provides products or services. A company may be the manufacturer of equipment instances or own the facility or laboratory where a chemical analysis is done. A company has an identifier and a name. It is also located in a country.

Coordinate. A coordinate is the angular component in a global position. A coordinate is specified in degrees, minutes, and seconds to whatever level of precision is required (often simply degrees and minutes). A global position has two coordinates, i.e., latitude and longitude. (Note the north-south and east-west codes are included as part of the global position, not the coordinate.)

Country. A country is any country, which may or may not participate in a treaty. (In a complete model there should be an entry date for when a country became associated or started to participate in a treaty and, correspondingly, a withdrawal date when it ceased to participate.) Countries are identified by a two-character country code and have a country name. At this time, the model does not include dates for when a country came into existence or when it disappeared — for example, the dissolution of the Soviet Union and the creation of its successor states, some of which are currently nuclear powers.

Country-site. Country sites are special types of sites and were included to support certain CFE requirements. Normally, a site is located within a country and all of the inspections of that site only need to involve that country. However, in some cases there are sites that are located in one country, but are owned and/or operated by another country, e.g., U.S. bases in Germany. In this case, both countries must be involved and have certain responsibilities during an inspection and the inspection may be triggered by an interest in either U.S. or German sites.

Date. Date is simply the concept of a date, which is stored in one form, but which may be output in any number of formats.

Declaration-limit. The declaration limit specifies how many declarations of an intent to inspect that a country must accept under a treaty during a period of time (usually a year). For example, a treaty may obligate a country to accept five declarations during a year. Note that a declaration is not the same thing as an inspection since several inspections can be included under a single declaration. However, there is a time limit for how long an inspection team can stay in a country under a declaration.

Document. A document is a generic term for any set of information in either hardcopy or electronic form (although not a database). A document is identified by a document identifier (doc-id) and a version. Examples of documents include treaty-site diagrams and descriptions.

Equip-instance. An equipment instance is a piece of equipment, such as a machine tool. It is identified by a serial number, is of a type (hier-equip-type), and is in a location. During a defensive inspection, you may want to know what equipment the inspectors saw. During an offensive inspection, you may want to plan your inspection to make sure you check certain pieces of equipment.

Equipment. See Equip-instance and Hier-equip-type.

Escort. An escort is a subtype of person, so all of the facts relating to a person also relate to an escort. An escort usually works at or for the site being inspected or the OSIA (On-Site Inspection Agency). An escort may be assigned to an inspector or to a specific area and will deal with any inspector who comes through the area. Escorts have specific duties and responsibilities, some of which are specified by the treaty under which the inspection is being conducted.

Escort-observer. An escort observer is a "friendly" observer who may be allowed to accompany the inspection, but who has no treaty-specified rights or responsibilities.

Escort-team. An escort team is the collection of all of the escorts for a specific inspection at a specific site. An escort team may have a permanent existence, but usually it is simply the collection of individual escorts pulled together for a specific inspection.

ESH-requirement. Environment, Safety, and Health Requirements may relate to locations and/or processes. Since both locations and processes are included in the information model, their ES&H requirements must also be included. All personnel (e.g., inspectors and escorts) must receive the appropriate training and conform to the ES&H requirements during the inspection.

Function. The high-level function is performed at a site that may perform more than one function. Currently, this concept is fuzzy, but examples might be manufacturing, precision machining, enrichment, or genetic research. If refined, it could be a useful discriminator — "list all of the sites that can do function X."

Global-position. Global position specifies the exact position of a point, which may be a site or building reference point. Global position may be determined by a GPS reading. Global position includes latitude, longitude, and elevation. Latitude and longitude are specified by a coordinate (angle) and a code (i.e., north-south or east-west).

Hier-equip-type. This object specifies equipment type. The concept of a hierarchy was included because there may be a general structure of equipment types. For example, a welding machine is more general than a laser welding machine. There is a similar structure for manufacturing processes.

Insp-final-report. At the end of an inspection, a final report is prepared, usually jointly by the inspection team and the site officials. This report is a document. It specifies any anomalies found, their resolution if any, and any other information the participants wish to include.

Inspectable-area. An inspectable area is that part of a site inspectable under a certain treaty. For example, part of Sandia may be inspectable under the NPT, while other parts may be inspectable under the CWC. Other parts, such as common areas, may not be formally inspectable, but can be walked through and observed.

Inspectable-org. Inspectable organization is a concept from the CFE treaty. A military unit or organization may be inspectable under some treaties to ensure that its equipment conforms to treaty specifications. However, the unit may be located at many sites. In this case, what is inspectable is the organization itself and the inspectors can go to as many sites as are necessary. This is in contrast to the usual approach where a site is what is being inspected, and if the inspectors go to additional sites they count as additional inspections.

Inspection. An inspection occurs when an inspection team goes to a site and examines it for compliance with the terms and conditions specified by the treaty under which the inspection is performed. (Note: Under some treaties, such as the CWC, only sites are inspected; but under other treaties, such as CFE, sites or units may be inspected. In the latter case, a new term — Object of Verification (OOV) — is often used, where an OOV can be either a site or a unit.) Inspections must be authorized under a treaty and are announced ahead of time by an inspection declaration. The treaty specifies the rules under which the inspection is carried out. The result of the inspection is a final report, which may identify one or more anomalies. Violations represent a political judgement and decision about the seriousness of the anomalies. This judgement is not made at the site by the inspection team, which only deals with anomalies.

Inspection-declare. An inspection-declare is a declaration of the intent to inspect.

Inspection-team. An inspection team is the collection of all of the inspectors for a specific inspection declaration, which may cover inspections at one or more specific sites. An inspection team may have a permanent existence, but usually it is simply the collection of individual inspectors pulled together for a specific declaration or set of inspections.

Inspection-type. Treaties authorize various types of inspections. Examples include baseline inspections to establish a starting point, shutdown inspections when a facility is being permanent closed, and routine inspections.

Inspector. An inspector is a subtype of person, so all of the facts relating to a person also relate to an inspector. An inspector is usually either a citizen of the inspecting country or an employee of a monitoring organization such as the International Atomic Energy Agency (IAEA). Inspectors have specific duties, rights, and responsibilities, which are specified by the treaty under which the inspection is being conducted.

Inspector-observer. An inspector observer is a special "unofficial member of the inspection team, who may be allowed to accompany the inspection, but who has no specific, treaty-specified rights or responsibilities."

Itinerary. Inspectors can ask to see various locations, equipment, and/or processes at a site. An itinerary is a subset of an inspection where one or more inspectors and their escorts make several stops at a site to inspect requested items. An inspection may consists of one itinerary (if all of the inspectors stay together and see the same things) or it may consist of many itineraries done sequentially or in parallel (where different inspectors examine different parts of the site).

Linear-dimension. Linear dimension is simply the common unit (measured in a specified metric or English unit) for measuring distances such as length, width, height, or elevation.

Location. A location is a precise point within a site, for example a room within a building within a site.

Mandate. The mandate specifies the purpose of the inspection, i.e., what the site is suspected of doing. In this usage, a mandate only applies to challenge inspections where there is suspected treaty violations or anomalies. Mandates do not apply to routine inspections.

Mandate-item. A mandate may indicate several suspected violations, for example the possession and manufacture of several precursor chemicals. The mandate item is a single item or suspected violation within the overall mandate.

Organization. An organization is either a company or a subunit within a company.

Path-segment. A path segment is part of the itinerary for an inspection. The inspection itinerary includes a number of stops and a path segment is the segment between any two of those stops.

Person. Person is a supertype that contains the basic information (facts) common for every person. It includes facts such as identifier, name, birth date, and citizenship. Additional information is captured in subtypes based on the one or more roles the person plays. Examples of these subtypes include inspectors, escorts, escort-observers, and inspector-observers.

Point-of-entry. A point-of-entry is the city through which an inspection team must enter a country. Points-of-entry for each country are specified in the treaty. Points-of-entry may be related to specific sites to be inspected. For example, New York may be the point-of-entry for Oak Ridge, and San Francisco the point-of-entry for Sandia.

Process. A process is an activity that may be performed at a location.

Region. A region is simply a geographic area defined in some way by a treaty. It may be a list of countries, parts of countries, or a set of boundaries from specific points or landmarks.

Sample. A sample, e.g., a chemical sample, may be taken at any point during the inspection for further analysis to identify suspected clandestine activity or to confirm that such activity is not occurring.

Site. A site is normally the largest area subject to an inspection under a specific treaty. Inspecting more than one site is normally considered multiple inspections. The main exception is that under CFE, a single inspection of a military unit includes all of the sites at which that unit is based.

Site-type. At one level, site type specifies the type of activity at the site, e.g., nuclear or chemical. At another level it may include the status of the site, e.g., shut down processing for a former chemical site.

Special-facility. Any special facilities that need to be called out for the site.

Specific-tl-item. A specific treaty-limited item is simply a more precise or more detailed identification of a type of item. For example, a TL-item may be fighters, whereas a Specific-tl-item may be F-15E or F-18. Each type of TL-item (e.g., fighters, tanks, APCs, or attack helicopters) can have a list of specific treaty-limited items of that type.

Stop. During the inspection, the inspectors may stop at any point to ask questions, examine something in more detail, or request a sample. The stop provides information about this activity.

Stop-comment. Any relevant comment an inspector made during a stop.

Technology. Technology identifies the technology involved in either a type of equipment or a process found at a site.

Time. A timestamp used as part of the identifier for a stop.

TL-equipment. See TL-item.

TL-item. A Treaty-Limited Item (TL-item) is any item in any way limited by the terms of a treaty. These limits may involve the development, production, deployment, use, retirement, decommissioning, and/or disposal of an item. Item is used in a generic sense and may include any of three subtypes of items — equipment, processes, or munitions. The TL-items, their limits, and inspection procedures for verifying compliance are all specified in one or more treaty clauses.

TL-munitions. See TL-item.

TL-process. See TL-item.

Treaty. A treaty is an international agreement signed and ratified by a group of participating countries that specifies a set of rules of behavior in certain areas and possibly sanctions for noncompliance. For example, with arms control treaties, there are precise definitions of what is being controlled, how it is to be controlled, how it may be disposed of, and how to conduct inspections to verify a country's compliance with the treaty terms. All of these points are defined and described in detail in specific treaty clauses, which are uniquely identified.

Treaty-clause. See Treaty.

Treaty-limit. See TL-item (Treaty-Limited Item).

Treaty-site-desc. The treaty-site-description is a document that describes the general functions, activities, and equipment of the entire site, part of which may not be covered under the specific treaty. It provides a more detailed description for functions and activities of the site covered by the treaty. A site may have many of these descriptions because they are specific to each treaty under which the site is covered.

Treaty-site-dgrm. The treaty-site-diagram is a document or map that shows the general layout (e.g., building outlines, roads, and fences) of the entire site, part of which may not be covered under the specific treaty. It provides a more detailed layout for that part of the site covered by the treaty. A site may have many of these diagrams because they are specific to each treaty under which the site is covered.

4. Lessons Learned

Overall the GIS software provided a useful tool for presenting data to help in conducting on-site inspections. However, during the inspection, data collection took time and limited the speed of the inspection process. Other data collection methods, such as video and audio with later entry into the database, would have speeded up the inspection process, but then the data would not have been available until after the inspection. There is also a major hurdle in data collection and processing to prepare a site for an inspection. These pre-inspection activities include collecting and reducing the geographic data and creating, building, and maintaining the necessary databases.

The natural language-based information modeling methodology helped provide a better understanding of the inspection process and its data requirements. It also helped integrate concepts across arms control treaties. There was no difficulty linking the model results within the GIS context. The major limitation was that the GIS used for the prototype was implemented using dBase, which has certain limitations. These limitations prevented us from using the database schema generated directly from the information modeling tool. However, the information model and the understanding developed during the modeling process provided the implementers with an effective starting point and allowed rapid design of the prototype database.

The OSIS model reused and/or built on a number of the objects (e.g., coordinate, global position, and site) from other data fusion information models. This reuse would increase with a more detailed model or with inspections for a different type of treaty. For example, the CFE treaty would probably have included vehicle types, configurations, and images from the information model for a SAR system.

5. Next Steps

This work can continue along at least two different paths: First, the on-site inspection aspect of the work could continue to extend and refine the prototype and/or move in the direction of a more complete information system to support on-site inspections, preferable in a broad multitreaty context for both the defensive and offensive modes, i.e., return to, extend, and implement the broader initial model. However, ideally this should be done within the context of a real customer who has specific requirements. In fact, demonstrations have been provided to a number of potential customers, who have expressed an interest in the system. Discussions are continuing with these customers.

Another path would take the work more into the data fusion area. This approach would extend the information model with specific types of targets and behaviors likely to be encountered in arms control inspection situations, the way they would be perceived by various types of sensors that could either be carried in by an inspection team or left at a site permanently for long term monitoring. For more information on this approach, see SAND97-0195, *Information Integration for Data Fusion*, Section 4, "Data Fusion and Information Modeling Technology for Nonproliferation," which also addresses the use of information modeling technology for cross-treaty and cross-methods synergy.

Appendix:

Complete On-Site Inspection System Information Model from CASE Tool (PC/IAST)

Elementary Sentence.

A 2-LTR-COUNTRY-CODE is a LABEL TYPE with representation Character 30.
A 2-LTR-COUNTRY-CODE may be IDENTIFIER-FOR at most one COUNTRY.

An ALLIANCE is an OBJECT.
An ALLIANCE must be IDENTIFIED-BY exactly one ALLIANCE-NAME.
An ALLIANCE must be INCLUDING one or more COUNTRY's.

An ALLIANCE-NAME is a LABEL TYPE with representation Character 80.
An ALLIANCE-NAME may be IDENTIFIER-FOR at most one ALLIANCE.

An ANALYSIS is an OBJECT.
An ANALYSIS must be ASSOCIATED-WITH one or more TL-ITEM's.
An ANALYSIS must be DONE-AT exactly one LOCATION.
An ANALYSIS must be DONE-BY exactly one ORGANIZATION.
An ANALYSIS must be DONE-ON exactly one DATE.
An ANALYSIS must be DONE-ON exactly one SAMPLE.
An ANALYSIS must be FOR exactly one INSPECTOR.
An ANALYSIS must be IDENTIFIED-BY exactly one ANALYSIS-ID.
An ANALYSIS must be PRODUCING exactly one ANALYSIS-RESULT.
An ANALYSIS must be WITH exactly one ANALYSIS-TYPE.
Every ANALYSIS
 is associated uniquely with one combination of
 an ANALYSIS ID IDENTIFIER FOR the ANALYSIS
and an ORGANIZATION PERFORMING the ANALYSIS.

An ANALYSIS-ID is a LABEL TYPE with representation Numeric 5.
An ANALYSIS-ID may be IDENTIFIER-FOR any number of ANALYSIS's.

An ANALYSIS-RESULT is a LABEL TYPE with representation Character 80.
An ANALYSIS-RESULT may be PRODUCED-FOR any number of ANALYSIS's.

An ANALYSIS-TYPE is a LABEL TYPE with representation Character 30.
An ANALYSIS-TYPE may be FOR any number of ANALYSIS's.

Elementary Sentence.

An ANOMALY is an OBJECT.
An ANOMALY must be ASSOCIATED-WITH one or more TREATY-CLAUSE's.
An ANOMALY must be DISCOVERED-BY exactly one PERSON.
An ANOMALY must be INCLUDED-IN exactly one INSP-FINAL-REPORT.
An ANOMALY must be SEQUENCED-BY exactly one ANOMALY-SEQ-NBR.
Every ANOMALY
 is associated uniquely with one combination of
 an INSP FINAL REPORT INCLUDING the ANOMALY
and an ANOMALY SEQ NBR SEQUENCE FOR the ANOMALY.

An ANOMALY-SEQ-NBR is a LABEL TYPE with representation Numeric 5.
An ANOMALY-SEQ-NBR may be SEQUENCE-FOR any number of ANOMALY's.

An AUTHOR is a LABEL TYPE with representation Character 40.
An AUTHOR may be WRITER-OF any number of DOCUMENT's.

A BUILDING is an OBJECT.
A BUILDING must be IDENTIFIED-BY exactly one BUILDING-ID.
A BUILDING may be INCLUDING any number of LOCATION's.
A BUILDING must be WITHIN exactly one SITE.
Every BUILDING
 is associated uniquely with one combination of
 a SITE INCLUDING the BUILDING
and a BUILDING ID IDENTIFIER FOR the BUILDING.

A BUILDING-ID is a LABEL TYPE with representation Character 30.
A BUILDING-ID may be IDENTIFIER-FOR any number of BUILDING's.

A CITY is an OBJECT.
A CITY must be IDENTIFIED-BY exactly one CITY-NAME.
A CITY must be LOCATED-IN exactly one COUNTRY.
A CITY may be LOCATION-FOR at most one POINT-OF-ENTRY.
Every CITY
 is associated uniquely with one combination of
 a CITY NAME IDENTIFIER FOR the CITY
and a COUNTRY LOCATION FOR the CITY.

Elementary Sentence.

A CITY-NAME is a LABEL TYPE with representation Character 30.
A CITY-NAME may be IDENTIFIER-FOR any number of CITY's.

A CNTRY-SITE-ID is a LABEL TYPE with representation Character 6.
A CNTRY-SITE-ID may be IDENTIFIER-FOR at most one COUNTRY-SITE.

A COMMENT is an OBJECT.
A COMMENT must be DESCRIBED-BY exactly one COMMENT-TEXT.
A COMMENT may be FOR any number of STOP-COMMENT's.
A COMMENT must be IDENTIFIED-BY exactly one COMMENT-SEQ-NBR.

A COMMENT-SEQ-NBR is a LABEL TYPE with representation Numeric 6.
A COMMENT-SEQ-NBR may be IDENTIFIER-FOR at most one COMMENT.

A COMMENT-TEXT is a LABEL TYPE with representation Character 80.
A COMMENT-TEXT may be DESCRIBING any number of COMMENT's.

A COMPANY is an OBJECT.
A COMPANY must be IDENTIFIED-BY exactly one COMPANY-CODE.
A COMPANY may be MFG-FOR any number of EQUIP-INSTANCE's.

A COMPANY-CODE is a LABEL TYPE with representation Character 30.
A COMPANY-CODE may be IDENTIFIER-FOR at most one COMPANY.

A COORDINATE is an OBJECT.
A COORDINATE may be LATITUDE-ANGLE-OF any number of GLOBAL-POSITION's.
A COORDINATE may be LONGITUDE-ANGLE-OF any number of GLOBAL-POSITION's.
A COORDINATE must be PARTIALLY-ID-BY exactly one DEGREES.
A COORDINATE must be PARTIALLY-ID-BY exactly one MINUTES.
Every COORDINATE
is associated uniquely with one combination of
a DEGREES PARTIAL ID FOR the COORDINATE
and a MINUTES PARTIAL ID FOR the COORDINATE.

Elementary Sentence.

A COUNTRY is an OBJECT.
A COUNTRY may be DECLARING any number of INSPECTION-DECLARE's.
A COUNTRY may be DOING any number of DECLARATION-LIMIT's.
A COUNTRY may be DUAL-CITIZEN-FOR any number of PERSON's.
A COUNTRY may be FOR any number of COUNTRY-SITE's.
A COUNTRY may be FOR any number of POINT-OF-ENTRY's.
A COUNTRY must be IDENTIFIED-BY exactly one 2-LTR-COUNTRY-CODE.
A COUNTRY may be INCLUDED-IN any number of ALLIANCE's.
A COUNTRY may be INCLUDED-IN any number of REGION's.
A COUNTRY may be LOCATION-FOR any number of CITY's.
A COUNTRY may be LOCATION-OF any number of TREATY-LIMIT's.
A COUNTRY may be OWNER-FOR any number of TREATY-LIMIT's.
A COUNTRY may be OWNER-OF any number of COUNTRY-SITE's.
A COUNTRY may be RECORD-COUNTRY-OF any number of PERSON's.
A COUNTRY may be TARGET-OF any number of INSPECTION-DECLARE's.
A COUNTRY may be UNDERGOING any number of DECLARATION-LIMIT's.
A COUNTRY must be WITH exactly one COUNTRY-NAME.

A COUNTRY-NAME is a LABEL TYPE with representation Character 80.
A COUNTRY-NAME may be FOR any number of COUNTRY's.

A COUNTRY-SITE is an OBJECT.
A COUNTRY-SITE must be COVERED-BY one or more TREATY's.
A COUNTRY-SITE must be IDENTIFIED-BY exactly one CNTRY-SITE-ID.
A COUNTRY-SITE must be IN exactly one COUNTRY.
A COUNTRY-SITE must be OWNED-BY exactly one COUNTRY.

A DATE is an OBJECT.
A DATE may be DATE-DECLARED-FOR any number of INSPECTION-DECLARE's.
A DATE may be DATE-DONE-FOR any number of ANALYSIS's.
A DATE may be DATE-FOR any number of SAMPLE's.
A DATE may be DATE-OF-BIRTH-FOR any number of PERSON's.
A DATE may be END-DATE-FOR any number of INSPECTION's.
A DATE may be ENTRY-DATE-FOR any number of INSPECTION-DECLARE's.
A DATE may be OF-EXIT-FOR any number of INSPECTION-DECLARE's.
A DATE may be OF-ORIGINATION-FOR any number of DOCUMENT's.
A DATE must be PARITIAL-ID-BY exactly one DAY-CODE.
A DATE must be PARTIAL-ID-BY exactly one MONTH-CODE.
A DATE must be PARTIAL-ID-BY exactly one YEAR-CODE.
A DATE may be STARTING-DATE-FOR any number of INSPECTION's.
Every DATE
is associated uniquely with one combination of
a DAY CODE PARTIAL ID FOR the DATE
and a MONTH CODE PARTIAL ID FOR the DATE
and a YEAR CODE PARTIAL ID FOR the DATE.

Elementary Sentence.

A DAY-CODE is a LABEL TYPE with representation Character 2.
A DAY-CODE may be PARTIAL-ID-FOR any number of DATE's.

A DECLARATION-LIMIT is an OBJECT.
A DECLARATION-LIMIT must be BY exactly one COUNTRY.
A DECLARATION-LIMIT must be DEFINED-AS exactly one NBR-OF-DECLARATION.
A DECLARATION-LIMIT must be FOR exactly one COUNTRY.
A DECLARATION-LIMIT must be FOR exactly one PERIOD-OF-TIME.
A DECLARATION-LIMIT must be SPECIFIED-FOR exactly one TREATY.
Every DECLARATION LIMIT
is associated uniquely with one combination of
a TREATY SPECIFYING MAX the DECLARATION LIMIT
and a COUNTRY UNDERGOING the DECLARATION LIMIT
and a COUNTRY DOING the DECLARATION LIMIT.

A DEGREES is a LABEL TYPE with representation Numeric 7.
A DEGREES may be PARTIAL-ID-FOR any number of COORDINATE's.

A DOCUMENT is an OBJECT.
A DOCUMENT must be ORIGINATED-ON exactly one DATE.
A DOCUMENT must be PARTIALLY-ID-BY exactly one DOCUMENT-ID.
A DOCUMENT must be PARTIALLY-ID-BY exactly one VERSION.
A DOCUMENT may be REPRESENTING at most one TREATY-SITE-DESC.
A DOCUMENT may be REPRESENTING at most one TREATY-SITE-DGRM.
A DOCUMENT must be WITH exactly one DOCUMENT-TYPE.
A DOCUMENT must be WRITTEN-BY exactly one AUTHOR.
Every DOCUMENT
is associated uniquely with one combination of
a DOCUMENT ID PARTIAL ID FOR the DOCUMENT
and a VERSION PARTIAL ID FOR the DOCUMENT.

A DOCUMENT-ID is a LABEL TYPE with representation Character 6.
A DOCUMENT-ID may be PARTIAL-ID-FOR any number of DOCUMENT's.

A DOCUMENT-TYPE is a LABEL TYPE with representation Character 5.
A DOCUMENT-TYPE may be FOR any number of DOCUMENT's.

Elementary Sentence.

An EQUIP-INSTANCE is an OBJECT.
An EQUIP-INSTANCE may be CARRIED any number of INSPECTION-TEAM's.
An EQUIP-INSTANCE may be CARRIED-BY any number of ESCORT-TEAM's.
An EQUIP-INSTANCE may be CARRIED-ON any number of ITINERARY's.
An EQUIP-INSTANCE must be MFG-BY exactly one COMPANY.
An EQUIP-INSTANCE must be OF-TYPE exactly one HIER-EQUIP-TYPE.
An EQUIP-INSTANCE must be PARTIALLY-ID-BY exactly one SERIAL-NBR.
Every EQUIP INSTANCE
is associated uniquely with one combination of
a COMPANY MFG FOR the EQUIP INSTANCE
and a SERIAL NBR PARTIAL ID FOR the EQUIP INSTANCE.

An ESCORT is an OBJECT.
An ESCORT is always a kind of PERSON.
An ESCORT may be CHIEF-ESCORT-FOR any number of ESCORT-TEAM's.
An ESCORT may be ESCORT-FOR any number of STOP's.
An ESCORT may be FOR any number of LOCATION's.
An ESCORT may be OVERHEARING any number of STOP-COMMENT's.
An ESCORT must be PART-OF one or more ESCORT-TEAM's.
An ESCORT may be TAKING any number of SAMPLE's.

An ESCORT-OBSERVER is an OBJECT.
An ESCORT-OBSERVER is always a kind of PERSON.

An ESCORT-TEAM is an OBJECT.
An ESCORT-TEAM may be CARRYING any number of EQUIP-INSTANCE's.
An ESCORT-TEAM must be ESCORTING one or more INSPECTION's.
An ESCORT-TEAM must be IDENTIFIED-BY exactly one ESCORT-TEAM-ID.
An ESCORT-TEAM must be INCLUDING one or more ESCORT's.
An ESCORT-TEAM must be INCLUDING-A-CHIEF exactly one ESCORT.

An ESCORT-TEAM-ID is a LABEL TYPE with representation Character 6.
An ESCORT-TEAM-ID may be IDENTIFIER-FOR at most one ESCORT-TEAM.

An ESH-REQUIREMENT is an OBJECT.
An ESH-REQUIREMENT may be ASSOCIATED-WITH any number of PROCESS's.
An ESH-REQUIREMENT must be IDENTIFIED-BY exactly one ESH-REQUIREMENT-ID.
An ESH-REQUIREMENT may be REGULATING any number of LOCATION's.

Elementary Sentence.

An ESH-REQUIREMENT-ID is a LABEL TYPE with representation Character 30.
An ESH-REQUIREMENT-ID may be IDENTIFIER-FOR at most one ESH-REQUIREMENT.

A FUNCTION is an OBJECT.
A FUNCTION must be IDENTIFIED-BY exactly one FUNCTION-ID.
A FUNCTION may be PERFORMED-AT any number of SITE's.

A FUNCTION-ID is a LABEL TYPE with representation Character 6.
A FUNCTION-ID may be IDENTIFIER-FOR at most one FUNCTION.

A GLOBAL-POSITION is an OBJECT.
A GLOBAL-POSITION may be COORDINATES-FOR any number of SITE's.
A GLOBAL-POSITION must be FOR-LATITUDE exactly one COORDINATE.
A GLOBAL-POSITION must be LATITUDE-DIRECTION exactly one NESW-CODE.
A GLOBAL-POSITION must be LONGITUDE-DIRECT exactly one NESW-CODE.
A GLOBAL-POSITION must be LONGITUDE-FOR exactly one COORDINATE.
A GLOBAL-POSITION must be WITH-ELEVATION-OF exactly one LINEAR-DIMENSION.
Every GLOBAL POSITION
is associated uniquely with one combination of
a COORDINATE LATITUDE ANGLE OF the GLOBAL POSITION
and a NESW CODE LATITUDE DIRECTION the GLOBAL POSITION
and a COORDINATE LONGITUDE ANGLE OF the GLOBAL POSITION
and a NESW CODE LONGITUDE DIRECT the GLOBAL POSITION.

A HIER-EQP-TYPE-DESC is a LABEL TYPE with representation Character 80.
A HIER-EQP-TYPE-DESC may be DESCRIBING any number of HIER-EQUIP-TYPE's.

A HIER-EQUIP-TYPE is an OBJECT.
A HIER-EQUIP-TYPE must be DESCRIBED-BY exactly one HIER-EQP-TYPE-DESC.
A HIER-EQUIP-TYPE must be IDENTIFIED-BY exactly one HIER-EQUIP-TYPE-ID.
A HIER-EQUIP-TYPE may be INCORPORATING any number of TECHNOLOGY's.
A HIER-EQUIP-TYPE may be TYPE-OF any number of EQUIP-INSTANCE's.
A HIER-EQUIP-TYPE may be USED-FOR any number of PROCESS's.

A HIER-EQUIP-TYPE-ID is a LABEL TYPE with representation Character 6.
A HIER-EQUIP-TYPE-ID may be IDENTIFIER-FOR at most one HIER-EQUIP-TYPE.

Elementary Sentence.

An INSP-FINAL-REPORT is an OBJECT.
An INSP-FINAL-REPORT may be INCLUDING any number of ANOMALY's.
An INSP-FINAL-REPORT must be RESULT-OF exactly one INSPECTION.

An INSPCT-DCL-SEQ-NBR is a LABEL TYPE with representation Numeric 6.
An INSPCT-DCL-SEQ-NBR may be PARTIAL-ID-FOR any number of INSPECTION's.

An INSPCTN-TYP-DESC is a LABEL TYPE with representation Character 80.
An INSPCTN-TYP-DESC may be DESCRIBING any number of INSPECTION's.

An INSPECT-DECLARE-ID is a LABEL TYPE with representation Character 6.
An INSPECT-DECLARE-ID may be IDENTIFIER-FOR at most one INSPECTION-DECLARE.

An INSPECT-TYPE-DESC is a LABEL TYPE with representation Character 80.
An INSPECT-TYPE-DESC may be DESCRIPTION-FOR any number of INSPECTION-TYPE's.

An INSPECTABLE-AREA is an OBJECT.
An INSPECTABLE-AREA must be IDENTIFIED-BY exactly one OBJ-VERIFY-ID.
An INSPECTABLE-AREA may be LOCATION-OF any number of INSPECTABLE-ORG's.
An INSPECTABLE-AREA may be REVIEWED-BY any number of INSPECTION's.
An INSPECTABLE-AREA must be THRU exactly one POINT-OF-ENTRY.

An INSPECTABLE-ORG is an OBJECT.
An INSPECTABLE-ORG must be IDENTIFIED-BY exactly one INSPECTABLE-ORG-ID.
An INSPECTABLE-ORG must be LOCATED-IN one or more INSPECTABLE-AREA's.
An INSPECTABLE-ORG must be LOCATED-SITE one or more SITE's.

An INSPECTABLE-ORG-ID is a LABEL TYPE with representation Numeric 5.
An INSPECTABLE-ORG-ID may be IDENTIFIER-FOR at most one INSPECTABLE-ORG.

Elementary Sentence.

An INSPECTION is an OBJECT.
An INSPECTION must be ALLOWED-BY exactly one TREATY.
An INSPECTION must be CONSISTS-OF one or more INSPECTION-TYPE's.
An INSPECTION must be COVERED-BY exactly one INSPECTION-DECLARE.
An INSPECTION must be DESCRIBED-BY exactly one INSPCTN-TYP-DESC.
An INSPECTION must be ENDED-ON exactly one DATE.
An INSPECTION must be ESCORTED-BY exactly one ESCORT-TEAM.
An INSPECTION must be FOR exactly one INSPECTABLE-AREA.
An INSPECTION must be IDENTIFIED-BY exactly one INSPECTION-ID.
An INSPECTION must be INCLUDING one or more ITINERARY's.
An INSPECTION must be PARTIALLY-ID-BY exactly one INSPCT-DCL-SEQ-NBR.
An INSPECTION may be RESULTING-IN at most one INSP-FINAL-REPORT.
An INSPECTION may be SOURCE-FOR any number of SAMPLE's.
An INSPECTION must be STARTED-ON exactly one DATE.
Every INSPECTION
 is associated uniquely with one combination of
    an INSPECTION DECLARE COVERING the INSPECTION
and an INSPCT DCL SEQ NBR PARTIAL ID FOR the INSPECTION.

An INSPECTION-DECLARE is an OBJECT.
An INSPECTION-DECLARE must be COVERED-BY exactly one TREATY.
An INSPECTION-DECLARE may be COVERING any number of INSPECTION's.
An INSPECTION-DECLARE must be DECLARED-BY exactly one COUNTRY.
An INSPECTION-DECLARE must be DECLARED-ON exactly one COUNTRY.
An INSPECTION-DECLARE must be DECLARED-ON exactly one DATE.
An INSPECTION-DECLARE may be DECLARED-UNDER any number of MANDATE's.
An INSPECTION-DECLARE must be ENTERING-CITY-ON exactly one DATE.
An INSPECTION-DECLARE must be EXITING-CITY-ON exactly one DATE.
An INSPECTION-DECLARE must be FOR-ENTRY-AT exactly one POINT-OF-ENTRY.
An INSPECTION-DECLARE must be IDENTIFIED-BY exactly one INSPECT-DECLARE-ID.
An INSPECTION-DECLARE must be PERFORMED-BY exactly one INSPECTION-TEAM.

An INSPECTION-ID is a LABEL TYPE with representation Character 6.
An INSPECTION-ID may be IDENTIFIER-FOR at most one INSPECTION.

An INSPECTION-TEAM is an OBJECT.
An INSPECTION-TEAM may be CARRYING any number of EQUIP-INSTANCE's.
An INSPECTION-TEAM must be COMPOSED-OF one or more INSPECTOR's.
An INSPECTION-TEAM must be HAS-CHIEF exactly one INSPECTOR.
An INSPECTION-TEAM must be IDENTIFIED-BY exactly one INSPECTION-TEAM-ID.
An INSPECTION-TEAM may be INCLUDING any number of INSPECTOR-OBSERVER's.
An INSPECTION-TEAM must be PERFORMING one or more INSPECTION-DECLARE's.

Elementary Sentence.

An INSPECTION-TEAM-ID is a LABEL TYPE with representation Character 6.
An INSPECTION-TEAM-ID may be IDENTIFIER-FOR at most one INSPECTION-TEAM.

An INSPECTION-TYPE is an OBJECT.
An INSPECTION-TYPE may be ALLOWED-BY any number of TREATY-CLAUSE's.
An INSPECTION-TYPE may be CHECKED-FOR any number of TREATY-LIMIT's.
An INSPECTION-TYPE must be DESCRIBED-BY exactly one INSPECT-TYPE-DESC.
An INSPECTION-TYPE must be IDENTIFIED-BY exactly one INSPECTION-TYPE-ID.
An INSPECTION-TYPE may be USED-FOR any number of INSPECTION's.

An INSPECTION-TYPE-ID is a LABEL TYPE with representation Numeric 5.
An INSPECTION-TYPE-ID may be IDENTIFIER-FOR at most one INSPECTION-TYPE.

An INSPECTOR is an OBJECT.
An INSPECTOR is always a kind of PERSON.
An INSPECTOR may be CHIEF-FOR any number of INSPECTION-TEAM's.
An INSPECTOR must be MAKING one or more STOP-COMMENT's.
An INSPECTOR may be MEMBER-OF any number of INSPECTION-TEAM's.
An INSPECTOR may be REQUESTING any number of SAMPLE's.
An INSPECTOR may be REQUESTOR-FOR any number of ANALYSIS's.

An INSPECTOR-OBSERVER is an OBJECT.
An INSPECTOR-OBSERVER is always a kind of PERSON.
An INSPECTOR-OBSERVER must be ASSOCIATED-WITH one or more INSPECTION-TEAM's.

An ITEM-DESC is a LABEL TYPE with representation Character 80.
An ITEM-DESC may be DESCRIPTION-FOR any number of TL-ITEM's.

An ITINERARY is an OBJECT.
An ITINERARY must be ASSOCIATED-WITH exactly one INSPECTION.
An ITINERARY may be CARRYING any number of EQUIP-INSTANCE's.
An ITINERARY must be IDENTIFIED-BY exactly one ITINERARY-SEQ-NBR.
An ITINERARY must be INCLUDING one or more PERSON's.
An ITINERARY must be STOPS-AT one or more STOP's.
Every ITINERARY
is associated uniquely with one combination of
an INSPECTION INCLUDING the ITINERARY

Elementary Sentence.

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and an ITINERARY SEQ NBR IDENTIFIER FOR the ITINERARY.

An ITINERARY-SEQ-NBR is a LABEL TYPE with representation Numeric 6.
An ITINERARY-SEQ-NBR may be IDENTIFIER-FOR any number of ITINERARY's.

A LD-UNIT is a LABEL TYPE with representation Character 8.
A LD-UNIT may be UNITS-OF any number of LINEAR-DIMENSION's.

A LD-VALUE is a LABEL TYPE with representation Numeric 7.
A LD-VALUE may be VALUE-OF any number of LINEAR-DIMENSION's.

A LINEAR-DIMENSION is an OBJECT.
A LINEAR-DIMENSION may be ELEVATION-FOR any number of GLOBAL-POSITION's.
A LINEAR-DIMENSION must be IN-UNITS exactly one LD-UNIT.
A LINEAR-DIMENSION must be VALUE exactly one LD-VALUE.
Every LINEAR DIMENSION
is associated uniquely with one combination of
a LD UNIT UNITS OF the LINEAR DIMENSION
and a LD VALUE VALUE OF the LINEAR DIMENSION.

A LOCATION is an OBJECT.
A LOCATION may be ALONG any number of PATH-SEGMENT's.
A LOCATION may be CONTAINING any number of SPECIAL-FACILITY's.
A LOCATION may be FOR any number of SAMPLE's.
A LOCATION may be FOR any number of STOP's.
A LOCATION must be IDENTIFIED-BY exactly one LOCATION-ID.
A LOCATION may be INCLUDED-IN at most one BUILDING.
A LOCATION may be LOCATION-OF any number of ANALYSIS's.
A LOCATION must be OWNED-BY exactly one ORGANIZATION.
A LOCATION may be REGULATED-BY any number of ESH-REQUIREMENT's.
A LOCATION must be RELATED-TO exactly one SIZE.
A LOCATION may be WITH any number of ESCORT's.

A LOCATION-ID is a LABEL TYPE with representation Character 6.
A LOCATION-ID may be IDENTIFIER-FOR at most one LOCATION.

Elementary Sentence.

A MANDATE is an OBJECT.
A MANDATE must be FOR exactly one INSPECTION-DECLARE.
A MANDATE must be IDENTIFIED-BY exactly one MANDATE-ID.
A MANDATE may be INCLUDES any number of MANDATE-ITEM's.

A MANDATE-ID is a LABEL TYPE with representation Numeric 5.
A MANDATE-ID may be IDENTIFIER-FOR at most one MANDATE.

A MANDATE-ITEM is an OBJECT.
A MANDATE-ITEM must be FOR exactly one MANDATE.
A MANDATE-ITEM must be PARTIALLY-ID-BY exactly one MANDATE-SEQ-NBR.
A MANDATE-ITEM must be UNDER exactly one TREATY-LIMIT.
Every MANDATE ITEM
is associated uniquely with one combination of
a MANDATE INCLUDES the MANDATE ITEM
and a MANDATE SEQ NBR PARTIAL ID FOR the MANDATE ITEM.

A MANDATE-SEQ-NBR is a LABEL TYPE with representation Numeric 5.
A MANDATE-SEQ-NBR may be PARTIAL-ID-FOR any number of MANDATE-ITEM's.

A MINUTES is a LABEL TYPE with representation Numeric 7.
A MINUTES may be PARTIAL-ID-FOR any number of COORDINATE's.

A MONTH-CODE is a LABEL TYPE with representation Character 2.
A MONTH-CODE may be PARTIAL-ID-FOR any number of DATE's.

A NAME is a LABEL TYPE with representation Character 50.
A NAME may be FOR any number of PERSON's.

A NBR-OF-DECLARATION is a LABEL TYPE with representation Binary integer 2.
A NBR-OF-DECLARATION may be FOR any number of DECLARATION-LIMIT's.

Elementary Sentence.

A NESW-CODE is a LABEL TYPE with representation Character 1.
A NESW-CODE may be LATITUDE-DIRECTION any number of GLOBAL-POSITION's.
A NESW-CODE may be LONGITUDE-DIRECT any number of GLOBAL-POSITION's.

An OBJ-VERIFY-ID is a LABEL TYPE with representation Character 6.
An OBJ-VERIFY-ID may be IDENTIFIER-FOR at most one INSPECTABLE-AREA.

An ORGANIZATION is an OBJECT.
An ORGANIZATION must be IDENTIFIED-BY exactly one ORGANIZATION-ID.
An ORGANIZATION may be OWNED-BY any number of SITE's.
An ORGANIZATION may be OWNING any number of LOCATION's.
An ORGANIZATION may be PERFORMING any number of ANALYSIS's.

An ORGANIZATION-ID is a LABEL TYPE with representation Character 6.
An ORGANIZATION-ID may be IDENTIFIER-FOR at most one ORGANIZATION.

A PASSPORT-NBR is a LABEL TYPE with representation Character 6.
A PASSPORT-NBR may be GIVEN-TO any number of PERSON's.

A PATH-SEGMENT is an OBJECT.
A PATH-SEGMENT must be ENDING-POINT-FOR exactly one STOP.
A PATH-SEGMENT may be GOING-BY any number of LOCATION's.
A PATH-SEGMENT must be STARTING-POINT-FOR exactly one STOP.
Every PATH SEGMENT
 is associated uniquely with one combination of
     a STOP STARTS AT the PATH SEGMENT
and a STOP ENDS AT the PATH SEGMENT.

A PERIOD-OF-TIME is a LABEL TYPE with representation Numeric 6.
A PERIOD-OF-TIME may be FOR-COUNTING any number of DECLARATION-LIMIT's.

A PERSON is an OBJECT.
A PERSON must be ASSOCIATED-WITH exactly one NAME.

Elementary Sentence.
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A PERSON must be BORN-ON exactly one DATE.
A PERSON must be CITIZEN-OF exactly one COUNTRY.
A PERSON may be COMMANDER-FOR any number of SITE's.
A PERSON may be DISCOVERING any number of ANOMALY's.
A PERSON may be DUAL-CITIZEN-WITH any number of COUNTRY's.
A PERSON must be GIVEN exactly one PASSPORT-NBR.
A PERSON may be GOING-ON any number of ITINERARY's.
A PERSON must be IDENTIFIED-BY exactly one PERSON-ID.

A PERSON-ID is a LABEL TYPE with representation Character 6.
A PERSON-ID may be IDENTIFIER-FOR at most one PERSON.

A POINT-OF-ENTRY is an OBJECT.
A POINT-OF-ENTRY may be ENTRY-POINT-FOR any number of INSPECTION-DECLARE's.
A POINT-OF-ENTRY may be FOR any number of INSPECTABLE-AREA's.
A POINT-OF-ENTRY must be IN exactly one CITY.
A POINT-OF-ENTRY must be IN exactly one COUNTRY.
A POINT-OF-ENTRY may be SPECIFIED-BY any number of TREATY's.

A PROCESS is an OBJECT.
A PROCESS must be DESCRIBED-BY exactly one PROCESS-DESC.
A PROCESS must be IDENTIFIED-BY exactly one PROCESS-ID.
A PROCESS may be REGULATED-BY any number of ESH-REQUIREMENT's.
A PROCESS may be REQUIRES any number of TECHNOLOGY's.
A PROCESS may be USING any number of HIER-EQUIP-TYPE's.

A PROCESS-DESC is a LABEL TYPE with representation Character 80.
A PROCESS-DESC may be DESCRIBING any number of PROCESS's.

A PROCESS-ID is a LABEL TYPE with representation Character 6.
A PROCESS-ID may be IDENTIFIER-FOR at most one PROCESS.

A REGION is an OBJECT.
A REGION may be ASSOCIATED-WITH any number of TREATY-LIMIT's.
A REGION must be IDENTIFIED-BY exactly one REGION-CODE.
A REGION must be INCLUDING one or more COUNTRY's.
A REGION must be KNOWN-BY exactly one REGION-NAME.

Elementary Sentence.

A REGION-CODE is a LABEL TYPE with representation Numeric 5.
A REGION-CODE may be IDENTIFIER-FOR at most one REGION.

A REGION-NAME is a LABEL TYPE with representation Character 80.
A REGION-NAME may be FOR any number of REGION's.

A SAMPLE is an OBJECT.
A SAMPLE must be IDENTIFIED-BY exactly one SAMPLE-ID.
A SAMPLE must be REQUESTED-BY exactly one INSPECTOR.
A SAMPLE must be TAKEN-AT exactly one LOCATION.
A SAMPLE must be TAKEN-BY exactly one ESCORT.
A SAMPLE must be TAKEN-DURING exactly one INSPECTION.
A SAMPLE must be TAKEN-ON exactly one DATE.
A SAMPLE may be TESTED-BY any number of ANALYSIS's.

A SAMPLE-ID is a LABEL TYPE with representation Numeric 5.
A SAMPLE-ID may be IDENTIFIER-FOR at most one SAMPLE.

A SERIAL-NBR is a LABEL TYPE with representation Character 6.
A SERIAL-NBR may be PARTIAL-ID-FOR any number of EQUIP-INSTANCE's.

A SITE is an OBJECT.
A SITE is always a kind of INSPECTABLE-AREA.
A SITE must be ASSOCIATED-WITH exactly one SITE-TYPE.
A SITE must be ASSOCIATED-WITH exactly one TREATY-SITE-DESC.
A SITE may be ASSOCIATED-WITH any number of TREATY-SITE-OGRN's.
A SITE must be COMMANDED-BY exactly one PERSON.
A SITE must be COVERED-BY one or more TREATY's.
A SITE must be DESCRIBED-BY exactly one SITE-DESC.
A SITE must be IDENTIFIED-BY exactly one SITE-ID.
A SITE may be INCLUDING any number of BUILDING's.
A SITE must be LOC-AT-COORDINATES exactly one GLOBAL-POSITION.
A SITE may be LOCATION-FOR any number of INSPECTABLE-ORG's.
A SITE must be OWNER-OF exactly one ORGANIZATION.
A SITE may be PERFORMING any number of FUNCTION's.
A SITE may be UNDER any number of TREATY-LIMIT's.

Elementary Sentence.

A SITE-DESC is a LABEL TYPE with representation Character 30.
A SITE-DESC may be DESCRIPTION-FOR any number of SITE's.

A SITE-ID is a LABEL TYPE with representation Character 6.
A SITE-ID may be IDENTIFIER-FOR at most one SITE.

A SITE-TYPE is an OBJECT.
A SITE-TYPE must be DESCRIBED-BY exactly one SITE-TYPE-DESC.
A SITE-TYPE may be FOR any number of SITE's.
A SITE-TYPE must be IDENTIFIED-BY exactly one SITE-TYPE-ID.
A SITE-TYPE may be UNDER any number of TREATY's.
A SITE-TYPE may be UNDER any number of TREATY-LIMIT's.

A SITE-TYPE-DESC is a LABEL TYPE with representation Character 80.
A SITE-TYPE-DESC may be DESCRIBING any number of SITE-TYPE's.

A SITE-TYPE-ID is a LABEL TYPE with representation Numeric 5.
A SITE-TYPE-ID may be IDENTIFIER-FOR at most one SITE-TYPE.

A SIZE is a LABEL TYPE with representation Numeric 6.
A SIZE may be FOR any number of LOCATION's.

A SPEC-FACILITY-ID is a LABEL TYPE with representation Character 6.
A SPEC-FACILITY-ID may be IDENTIFIER-FOR at most one SPECIAL-FACILITY.

A SPECIAL-FACILITY is an OBJECT.
A SPECIAL-FACILITY must be IDENTIFIED-BY exactly one SPEC-FACILITY-ID.
A SPECIAL-FACILITY may be LOCATED-AT any number of LOCATION's.

Elementary Sentence.

A SPECIFIC-TL-ITEM is an OBJECT.
A SPECIFIC-TL-ITEM must be COMPOSING exactly one TL-ITEM.
A SPECIFIC-TL-ITEM must be IDENTIFIED-BY exactly one SPECIFIC-TL-ITM-ID.

A SPECIFIC-TL-ITM-ID is a LABEL TYPE with representation Numeric 5.
A SPECIFIC-TL-ITM-ID may be IDENTIFIER-FOR at most one SPECIFIC-TL-ITEM.

A STOP is an OBJECT.
A STOP must be AT exactly one LOCATION.
A STOP may be ENDS-AT any number of PATH-SEGMENT's.
A STOP must be ESCORTED-BY one or more ESCORT's.
A STOP must be IDENTIFIED-BY exactly one STOP-SEQ-NBR.
A STOP may be NOTICED-IN any number of STOP-COMMENT's.
A STOP must be OCCURRED-AT exactly one TIME.
A STOP may be STARTS-AT any number of PATH-SEGMENT's.
A STOP must be STOP-FOR exactly one ITINERARY.
Every STOP
is associated uniquely with one combination of
an ITINERARY STOPS AT the STOP
and a STOP SEQ NBR IDENTIFIER FOR the STOP.

A STOP-COMMENT is an OBJECT.
A STOP-COMMENT must be CONTAINS exactly one COMMENT.
A STOP-COMMENT must be DOCUMENTATION-FOR exactly one STOP.
A STOP-COMMENT must be MADE-BY exactly one INSPECTOR.
A STOP-COMMENT may be OVERHEARD-BY any number of ESCORT's.
Every STOP COMMENT
is associated uniquely with one combination of
a COMMENT FOR the STOP COMMENT
and a STOP NOTICED IN the STOP COMMENT
and an INSPECTOR MAKING the STOP COMMENT.

A STOP-SEQ-NBR is a LABEL TYPE with representation Numeric 6.
A STOP-SEQ-NBR may be IDENTIFIER-FOR any number of STOP's.

A TECHNOLOGY is an OBJECT.
A TECHNOLOGY must be IDENTIFIED-BY exactly one TECHNOLOGY-ID.
A TECHNOLOGY may be INCORPORATED-BY any number of HIER-EQUIP-TYPE's.
A TECHNOLOGY may be REQUIREMENT-FOR any number of PROCESS's.

Elementary Sentence.

A TECHNOLOGY-ID is a LABEL TYPE with representation Character 6.
A TECHNOLOGY-ID may be IDENTIFIER-FOR at most one TECHNOLOGY.

A TIME is an OBJECT.
A TIME must be IDENTIFIED-BY exactly one TIME-STAMP.
A TIME may be OF-OCCURRENCE-FOR any number of STOP's.

A TIME-STAMP is a LABEL TYPE with representation Numeric 6.
A TIME-STAMP may be IDENTIFIER-FOR at most one TIME.

A TL-EQUIPMENT is an OBJECT.
A TL-EQUIPMENT is always a kind of TL-ITEM.

A TL-ITEM is an OBJECT.
A TL-ITEM may be ASSOCIATION-WITH any number of ANALYSIS's.
A TL-ITEM may be COMPOSED-OF any number of SPECIFIC-TL-ITEM's.
A TL-ITEM must be DESCRIBED-BY exactly one ITEM-DESC.
A TL-ITEM must be IDENTIFIED-BY exactly one TL-ITEM-ID.
A TL-ITEM may be ITEM-FOR any number of TREATY-LIMIT's.

A TL-ITEM-ID is a LABEL TYPE with representation Numeric 5.
A TL-ITEM-ID may be IDENTIFIER-FOR at most one TL-ITEM.

A TL-MUNITION is an OBJECT.
A TL-MUNITION is always a kind of TL-ITEM.

A TL-PROCESS is an OBJECT.
A TL-PROCESS is always a kind of TL-ITEM.

A TREATY is an OBJECT.

Elementary Sentence.

A TREATY must be CONSISTING-OF one or more TREATY-CLAUSE's.
A TREATY may be COVERING any number of COUNTRY-SITE's.
A TREATY may be COVERING any number of INSPECTION-DECLARE's.
A TREATY may be COVERING any number of SITE's.
A TREATY must be IDENTIFIED-BY exactly one TREATY-ID.
A TREATY may be RELATED-TO any number of SITE-TYPE's.
A TREATY may be SPECIFIES any number of POINT-OF-ENTRY's.
A TREATY may be SPECIFYING-AN any number of INSPECTION's.
A TREATY may be SPECIFYING-MAX any number of DECLARATION-LIMIT's.
A TREATY may be WITH any number of TREATY-SITE-DGRM's.

A TREATY-CLAUSE is an OBJECT.
A TREATY-CLAUSE may be ALLOWING any number of INSPECTION-TYPE's.
A TREATY-CLAUSE must be CONTAINING exactly one TREATY-CLAUSE-TEXT.
A TREATY-CLAUSE must be INCLUDED-IN exactly one TREATY.
A TREATY-CLAUSE must be PARTIALLY-ID-BY exactly one TREATY-CLAUSE-ID.
A TREATY-CLAUSE may be RELATED-TO any number of ANOMALY's.
A TREATY-CLAUSE may be SPECIFYING any number of TREATY-LIMIT's.
Every TREATY CLAUSE
is associated uniquely with one combination of
a TREATY CONSISTING OF the TREATY CLAUSE
and a TREATY CLAUSE ID PARTIAL ID FOR the TREATY CLAUSE.

A TREATY-CLAUSE-ID is a LABEL TYPE with representation Binary integer 5.
A TREATY-CLAUSE-ID may be PARTIAL-ID-FOR any number of TREATY-CLAUSE's.

A TREATY-CLAUSE-TEXT is a LABEL TYPE with representation Character 80.
A TREATY-CLAUSE-TEXT may be WRITTEN-FOR any number of TREATY-CLAUSE's.

A TREATY-ID is a LABEL TYPE with representation Character 6.
A TREATY-ID may be IDENTIFIER-FOR at most one TREATY.

A TREATY-LIMIT is an OBJECT.
A TREATY-LIMIT may be CHECKED-BY any number of INSPECTION-TYPE's.
A TREATY-LIMIT may be DECLARING any number of MANDATE-ITEM's.
A TREATY-LIMIT must be DECLARING exactly one TREATY-LIMIT-QTY.
A TREATY-LIMIT may be FOR any number of SITE's.
A TREATY-LIMIT may be FOR at most one SITE-TYPE.
A TREATY-LIMIT must be FOR exactly one TL-ITEM.
A TREATY-LIMIT may be FOR-OWNER at most one COUNTRY.

Elementary Sentence.

A TREATY-LIMIT may be IN at most one COUNTRY.
A TREATY-LIMIT may be IN at most one REGION.
A TREATY-LIMIT must be SPECIFIED-IN exactly one TREATY-CLAUSE.
Every TREATY LIMIT
is associated uniquely with one combination of
a TREATY CLAUSE SPECIFYING the TREATY LIMIT
and a TL ITEM ITEM FOR the TREATY LIMIT.

A TREATY-LIMIT-QTY is a LABEL TYPE with representation Numeric 3.
A TREATY-LIMIT-QTY may be DECLARED-UNDER any number of TREATY-LIMIT's.

A TREATY-SITE-DESC is an OBJECT.
A TREATY-SITE-DESC must be DESCRIBED-FOR exactly one SITE.
A TREATY-SITE-DESC must be REPRESENTED-IN one or more DOCUMENT's.

A TREATY-SITE-DGRM is an OBJECT.
A TREATY-SITE-DGRM must be FOR exactly one TREATY.
A TREATY-SITE-DGRM must be RELATED-TO exactly one SITE.
A TREATY-SITE-DGRM must be REPRESENTED-IN exactly one DOCUMENT.
Every TREATY SITE DGRM
is associated uniquely with one combination of
a TREATY WITH the TREATY SITE DGRM
and a SITE ASSOCIATED WITH the TREATY SITE DGRM.

A VERSION is a LABEL TYPE with representation Character 5.
A VERSION may be PARTIAL-ID-FOR any number of DOCUMENT's.

A YEAR-CODE is a LABEL TYPE with representation Character 2.
A YEAR-CODE may be PARTIAL-ID-FOR any number of DATE's.

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