assumptions. When forming an ontology of a subject domain based on one of the specified top-level ontologies, it can be more easily integrated with other subject ontologies. The problem is that there are quite a lot of top-level ontologies and giving preference to one of them becomes a certain search problem that requires a lot of time and effort. In addition, some of them do not have open access and are also badly compatible with the semantic Web.

The ISO 15926 ontology [17] is considered separately. This standard is not only a top-level ontology but also a thesaurus of the processing industry, including the structure of retention and access to the ontological base. Standardization is implemented by using well-defined templates for technical and operational information, that include classes and relations of the invariant and temporal parts of the ontology. The advantages of this ontological model are the typification and identification of data located on the Internet; information is stored in RDF-triplets, access to triplet storages occurs using the SPARQL query language, etc. When creating this model, the developers tried to cover all aspects of requests that may arise in manufacturing. As a result, the model has hundreds of nested classes and attributes at the lower levels of production (description of technological equipment), most of which may not be used in practice. The temporal part increases the complexity of the model several times.

Thus, the ontology according to the ISO 15926 standard is most suitable for the specified problem. However, it should be noted that, taking into account the need for a common equipment and ISA-88 knowledge base, it was decided to implement the equipment knowledge base using OSTIS. In addition, there are restrictions in the ISO 15926 standard that are not present in the OSTIS Technology.

IV. About ISA-88 and the criteria for the decomposition of technology and equipment

As already noted above, when creating the equipment hierarchy, an engineer faces a number of problems related to the need to take into account many factors. The larger the technological scheme in terms of the amount of equipment and the more connectivities it has, the more difficult it is to allocate logically related equipment in it. The difficulty also lies in the fact that the standards do not and cannot have all the criteria for allocation. Therefore, this problem should be considered both from the point of view of the limitations and functional requirements of the ISA-88 standard and from the point of view of experience from best practices. Both can be put into the knowledge base [18].

To begin with, let us highlight clear restrictions, using which it is quite easy to determine whether the equipment belongs to one of the hierarchy levels. According to ISA-88, these levels are:

1) the level of the process cells;
2) the level of units;
3) the level of equipment modules;
4) the level of control modules.

According to the standard, “a process cell is a logical grouping of special equipment that includes the equipment required for production of one, or more batches”. Exactly from the point of view of batch production, the process cell is distinguished. If the entire batch of semi-products is not developed in the framework of the process cell, the equipment that is needed for this should be included. Within one process cell, there may be several connected elements of special equipment capable of producing several batches in parallel. If batches cannot be separated, they remain within the same process cell. In addition, the process cell must contain at least one unit.

The allocation of units is a little less obvious. There are several clear criteria:

1) one unit cannot contain several batches;
2) each technological action occurs immediately (simultaneously) with all the material within one unit;
3) the technological operation begins and ends within the same unit.

Even less obvious conditions for choosing and combining are the statements:

- the unit can include all the equipment and control modules involved in technological actions;
- the unit can work with part of the batch.

All equipment, except for the control module, can implement procedural control. That is, from the point of view of technology, it contains some procedural elements that perform a technological operation, separating itself from the method of its implementation. There are operational directives, for example, “heat to the required temperature”, as opposed to the directives “open valve 1” or “if TE101 > 23, close the valve”. The last control directive refers to equipment, not technology, and is called “basic control” in the standard. This is the main criterion that determines the principle of allocating the control module – this equipment does not contain procedural control. In addition, this part of the hierarchy enables real interaction with concrete equipment, while the other levels are more role groups. Therefore, the level of control modules cannot be omitted in the hierarchy.

The concept of procedural control per se is also not clear enough. It is difficult to formalize it as well as to define in an ontology. However, according to the standard, there are certain features inherent in it, in contrast to the basic control, such as visibility at the recipe level, a characteristic state engine, abstraction from equipment, etc.

As for the control module, there is one indirect but very useful property as a selection criterion − this type of equipment is shown in the P&ID-schemes as instrumentation. According to the standard, the control