MODELING ASPECTS OF HYPER-COMPLEX PRODUCTS IN NUCLEAR ENGINEERING PROJECTS

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Nowadays High-Energy Physics (HEP) research with it ambitious goals intensify pressure on engineering activity for designing and construction of extraordinary scientific devices. HEP research sets ambitious goals to perceive what happened after the big bang, how matter was created, are there extra dimensions and microscopic black holes, etc. As a result facilities for the experiments become more and more complicated and it sets completely new engineering challenges for their design and construction. Several HEP international projects are going on today: LHC (Large Hadron Collider), Geneva, Switzerland; ITER (International Thermonuclear Experimental Reactor), Cadarache, France; FAIR (Facility for Antiproton and Ion Research), Darmstadt, Germany.

ATLAS collaboration is the part of LHC project. The aim of collaboration is to build world largest and most complex scientific facility. ATLAS detector is 46 meter long and 25 meter diameter device situated on 100 meter underground Geneva, Switzerland and weighted 7'000 tones. ATLAS collaboration unifies 169 partners from 37 countries with 2'500 scientists and engineers.

There is no similarity with traditional designing and construction approaches and methodologies implementing in auto-motto, aerospace or ship building fields. ATLAS detector designing and construction life cycle foresee execution of standard phases of Geometry_modeling – Engineering_analysis – Fabrication_and_Assembly – Installation – Survey_control. However, each of them characterized with special aspects:

Complexity of Geo Model

Detector has comparatively simple profiles, mostly lines and arc's but assemblies have enormous complexity. Development of entire geo model of detector is caring out by large number of collaborative partners in heterogeneous environment. Usually partner institutes are using the CAD platforms, design methodologies and designers which normally existing there before. No one is looking for to change the own basis while it is extremely costly. Therefore there are no strict requirements inside the collaboration for the implementation of one CAD platform. Thus, entire geo model is distributed into different representations which cause difficultness and in many cases it is impossible to implement of entire geo model without their migration.

High Dense Environment for Integration

High complexity cause high density of assemblies. Admissible clearance in ATLAS detector is 50mm.

Big Dimensions and High Accuracy for Fabrication and Assembly

Big dimensions of detectors part to be manufacture are constrained with strict requirements to maintain high accuracy of machining and assembly. For instance, Tile Calorimeter is the one of the part detector. It is 8 meter diameter, 6 meter length iron construction with 22 tones weight. It consists of 64 segments assembled with 50 micron accuracy.

Specific Areas and Conditions for the Installation

Large size of objects to be positioned, dense environment, underground installation and special approaches for the alignment cause difficultness to find out engineering solutions. ATLAS detector was installed in 100 meter underground. Installation precision was checked by 50 mm diameter alignment rays which are going through the detector without intersection up to the point preliminary setting up for the installation.

Survey Control

Big dimensions of HEP facilities makes impossible to do survey control in special workshops. It is possible just in the final place with implementation of special units and methodologies. ATLAS survey control was done by the laser scanning and comparison survey data with geo model.

Thus from one side we have special tasks for designing and construction and from other side distributed tasks between big amount of collaborative partners. Paper will represents unique methodologies and approaches to solve all above mentioned specific aspects. Also examples of case studies will be represented concerning to construction of ATLAS detector at CERN.