REVIEW REQUIREMENTS

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Compliance Office

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Outline

- *Validation Form*
- *Analysis Plan*
- *Memorandum*

Giuseppe Gallo - Background

- Mechanical Engineer with 10+ years of experience in mechanical design at FNAL

  - Member of the Technical Coord Staff – part of systems engineering team (last assignment)
  - Member of the Compliance Office (last assignment)
  - Lead engineer of Mu2e Tracker (last assignment)
  - Lead engineer of DESI barrel, cage and lens rotating mechanism (earlier assignment)

- Master degree in Mechanical Engineering (PISA-ITALY)

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1. Introduction and purpose

2. Analysis Plan

Analysis plan requirements:

- Name of the author/s and qualifications
- Scope and objective
- List of the design codes and fabrication/ assembly standards
- Identification of the load cases that occur during the transportation, installation, and operation
- Analysis methods for the individual models considering its integration into the global models
- List and brief description of structural tests if necessary to validate the engineering reports

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3. Structural Engineering File

A qualified engineer shall provide the structural engineering file that must contain:

1. The equipment analysis plan
2. The technical 2D drawings and geometrical 3D models
3. The transportation, the installation and the operation technical specifications
4. The structural design calculation notes
5. The required QA/QC documentation (that will be channelled to the CO by the DUNE QA/QC responsible).
6. The eventual testing documentation on structures and structural components of the equipment.
7. The final in situ equipment inspections before commissioning or operation.
8. All recommendations from the safety reviews related to the equipment together with the follow up actions.
9. All the documentation related to the acceptance or recommendations from the CO and the ESH manager.

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3.1 Technical drawings and geometrical models

3.2 Structural design calculation notes

3.2.1 Standard and regulations

3.2.2 Design

3.2.3 Mass budgets

3.2.4 Load cases and combinations

3.2.5 Materials

3.2.6 Structural modelling

3.2.7 Structural analysis

3.2.8 Safety verifications

3.2.9 Verifications toward the operation requirements

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3.3 Execution requirements and quality control

3.4 Variance / Derogation Process

3.5 Testing Plan

Annex 1 – List of US and European standards applicable for the Dune/LBNF project

Annex 2: Standards equivalency

EUROCODE equivalency White Paper - Acceptance of Steel and Aluminum Structures Designed per the EUROCODES at FERMILAB.

Table 1 – Selected Eurocodes and corresponding US code documents

Eurocode	Corresponding U.S. Code
EN 1990	IBC, ASCE 7, AISC 360, ADM1
EN 1991	ASCE 7
EN 1993	AISC 360
EN 1999	ADM1
EN 14620	(Not a Structural Code)

APA shipping frame analysis plan #EDMS????

Step 1: Compliance Office generated a memorandum

Step 2. - Compliance Office – guidance on the first draft based on the Validation Form EDMS #2172998:

1. Name of the author/s and qualifications
2. Scope and Objective
3. Description of the load cases, analysis methods, and design codes
4. Fabrication – location of the APA shipping frame fabrication
5. QA/QC plans and documentation – brief info related to QA/QC plans
6. Testing – brief info related to tests and reports
7. Schedule – analysis schedule, expected reviews and dates

Step 3. – Compliance Office – Review and sign-off the APA analysis plan. *(work in progress)*

Compliance Office Memorandum vs.6

The aim of this memorandum is to clarify the preliminary requirements from the Compliance Office (CO) in order to assess and ultimately validate the APA shipping frame.

The APA shipping frame is considered in its integrality as a Lifting Device based on the definitions of ASME B30-20-2013 section 20-0.2 or EN13155 paragraph 3.11.

The applicable standards for Design, Fabrication, and Quality Control are for the APA frame built, assembled and used in the US are:

ASME B30.20-2013 for below-the-hook lifting devices

ASME BTH-1-2017 (Design of Below-the-Hook Lifting Devices)

ANSI/AISC 360 (Specification for Structural Steel Buildings – American Institute of Steel Construction)

Structural Welding Codes: ANSI/AWS D14.1 and ASME BTH-1.

EN1090 (all applicable parts)- Execution of steel and aluminium structures.

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Nevertheless, the European standards below can be considered equivalent to the US standards mentioned above.

Directive machine - 2006/42/CE

EN 13155:2003 +A2: 2009: Cranes – Safety – Non-fixed Load Lifting Attachments

EN 1993 - EUROCODE 3 (all applicable parts): Design of steel structures

EN1090 (all applicable parts)- Execution of steel and aluminium structures.

Based on experience, we recommend to use the US standards or to make sure that the transportation company will accept both standards.

- DOE 10 CFR851 – Work Safety and Health Program

- DOE Standard DOE-STD-1090- 2011 – Hoisting and Rigging

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In addition, referring to the US standards mentioned above, we propose to classify the APA shipping frame **as:**

- DOE category "Critical lift" for lifting tools as defined in DOE STD-1090-2011 based on § 2.1 as the following conditions are met for an APA lifting frame:

2.1.2 B) The load item is unique and, if damaged, would be irreplaceable or not repairable and is vital to a system, facility or project operation.

2.1.2 C) The cost to replace or repair the load item, or the delay in operations of having the load item damaged would have a negative impact on facility, organizational, or DOE budgets to the extent that it would affect program commitment.

The requirement for the lifting devices DOE category – "critical lifts" are detailed in §2.2.

- Below the Hook Lifting device - Design Category A lifting equipment, Service Class 0 as defined in ASME BTH-1 Chapter 2, Table 2-3-1 and Appendix B.2.1 Table B-3-1 and ASME B30.20 section 20-0.4.

Detailed implication on the design requirements are detailed in EDMS XXX.

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APA frame mechanical strength will be verified via individual verification load tests.

The load tests of each APA frame shall follow the ASME B30.20 requirements.

Note that:

ASME B30.20 requires a load factor of maximum 1.25 of the work load limit to perform the load test (§ 20-1.3.8.2)

EN 13155 requires a load factor of 2 on the work load limit to perform the load test (§A.3.3).

The European Machine Directive requires a load factor on the work load limit of 1.5 to perform the load test.

We propose to use a **load factor of 1.5** on the work load limit to be compliant with the European and US regulation.

Any deviation from the standards shall be documented and communicated and to the CO who will assess the request and inform the LBNF/ DUNE ESH manager when required for his approval.

All the engineering design, fabrication, QC and documentation process has to follow the document "Validation of the DUNE/LBNF structures and mechanical components for equipment and detectors - EDMS #2172998".

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In order to prepare the Preliminary design review – “60 % review “of the APA shipping frame design, the following points are expected from the CO, at least 3 weeks in advance:

- The site of fabrication of the APA shipping frame, the number of items has to be provided.

- Material and lifting equipment

- Mass budget (with contingencies)

- Main load cases (with justification)

- Intended use: i.e. the different steps of use should be described for example unloading from a truck, transfer from horizontal position to the vertical position to lower in the Ross Shaft, reverse operation…) and a logistics scheme of the APA transport frame should be provided.

- All operational requirements:

At least the specification of the maximum displacements of the supporting points of the APA chambers should be provided.

- Structural analysis for the worst load cases

- Stability analysis

- Risk assessment

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- Proposed execution classes (EN 1090), proposed of a QC plan and expected delivery documents.

- Expected testing campaign for the APA frame (welds checks, load tests in the different handling configurations with the expected overload factor, functional tests of the different possible handling configurations at nominal load…).

- Expected schedule of the project (main milestones: reviews, fabrication, tests, etc..)

The APA frame lead engineer has to be communicated to the CO, he will take responsibility of the design, fabrication, QC and documentation of the lifting device.

Any change in the responsibility, in the schedule, in the project technical plans has to be communicated to the CO.

The interaction between the Project and the CO has to be channelled via the APA Frame lead engineer.

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THANKS

BACKUP

DOE STD 1090-2011

Critical Lifts

2.1 Critical Lift Determination

2.1.1 A designated person shall classify each lift into one of the DOE categories (ordinary, critical, personnel or pre-engineered production) prior to planning the lift.

2.1.2 A lift shall be classified critical if any of the following conditions are met:

A. If loss of control of the item being lifted would likely result in the declaration of an emergency as defined by the facility's emergency plan or construction site emergency plan.

B. The load item is unique and, if damaged, would be irreplaceable or not repairable and is vital to a system, facility or project operation.

C. The cost to replace or repair the load item, or the delay in operations of having the load item damaged would have a negative impact on facility, organizational, or DOE budgets to the extent that it would affect program commitments.

D. If mishandling or dropping of the load would cause any of the above noted consequences to nearby installations or facilities.

E. For steel erection, a lift shall be designated as a critical lift if:

1. The lift exceeds 75 percent of the rated capacity of the crane or derrick

OR

2. The lift requires the use of more than one crane or derrick (refer to 29 CFR 1926.751).

DOE STD 1090-2011

Section 5
Personnel Qualifications

5.1 General Requirements

5.1.1 This section specifies qualification/certification requirements for hoisting and rigging personnel.

5.1.2 Managers responsible for work assignments on hoisting and rigging activities shall ensure that assignments do not exceed personnel qualifications.

NOTE: *Hoisting and rigging personnel includes, but is not limited to, crane operators, forklift operators, riggers, signal persons, designated leaders, persons-in-charge, trainees, inspectors, maintenance personnel, assembly/disassembly director, and lift directors.*

5.2 Qualifications

5.2.1 Personnel performing hoisting and rigging activities specifically addressed by OSHA and national consensus standards shall be qualified per the OSHA and national consensus standards.

5.2.2 Personnel involved in hoisting and rigging activities for which qualification requirements are not specifically addressed by OSHA or national consensus standards shall:

A. Be physically qualified to perform the specific job requirements.

B. Complete training for the equipment type and/or assigned function.

5.2.3 Each site shall develop a requalification program for hoisting and rigging personnel. The requalification program shall reflect the complexity or changing nature of the site's hoisting and rigging operations and shall, at a minimum, comply with requalification requirements of referenced OSHA and ASME standards.

DOE-STD-1090-2011

5.3 Certification

5.3.1 Hoisting and rigging personnel certified by a nationally recognized certifying organization or a state/local agency recognized by Federal OSHA may be accepted as having met the basic qualification requirements for both construction and general industry hoisting and rigging operations.

5.3.2 A practical operating skill evaluation shall be conducted for the specific equipment type and/or assigned function. This evaluation shall be conducted before a work assignment.

5.4 Records

Qualification/certification records for hoisting and rigging personnel shall be kept on file and shall be readily available.