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Guidance on Practice: Electrically Driven Liquefaction Plant Electrical Systems Philosophy

GP 81-01

**BP GROUP
ENGINEERING TECHNICAL PRACTICES**

Foreword

This is the first issue of Engineering Technical Practice (ETP) BP GP 81-01.

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1. Introduction

1.1. General

This design philosophy recognises that a common approach to electrical design throughout the BP group is difficult to achieve because of differences in national standards and practices. However guidance is provided which should be of application worldwide.

This is a design philosophy, not a specification. That is why the word, “should,” is used instead of “shall” in the document. This is the way that BP suggests that particular project teams design their LNG liquification plants. The project teams may decide not to follow some, or all of these suggestions, but they should be ready to discuss their reasons for doing so during Peer Assists and Peer Reviews.

1.2. Scope

An Electrically Driven LNG Plant uses electric motors rather than gas turbines to drive the refrigeration compressors. The electrical power system includes a secure power supply to feed all loads associated with the LNG plant, an electrical distribution system and the various electric motors and associated equipment required to drive all processes within the plant. The key elements are the large electric motors used to drive the refrigeration compressors. These may be either fixed or variable speed depending on the process requirements.

The purpose of this document is to specify the broad principles for the basic electrical power system design and the associated operational requirements to support the LNG plant.

Although possible system configurations have been indicated in this document, alternative designs may be more appropriate in particular instances.

1.3. Codes and Standards

API Standard 546 Brushless Synchronous Machines - 500 kVA and Larger

2. General Requirements

The objective of the electrical power system is to ensure a safe, reliable and economic source of power for the LNG liquefaction plant. Key consideration should be given to continuous operating requirements and system maintainability.

IEC standards should generally be applied in the design of the electrical power system unless agreement has been reached with the client to apply other recognized international or national standards.

The design of the electrical power system should:

1. Ensure the safety of both facilities and personnel during normal and abnormal operating conditions.
2. Provide an appropriate degree of security to ensure that any specified reliability and availability targets are met. Security of supply should be achieved by means of appropriate levels of redundancy, interconnection and separation between circuits.
3. Make provision for emergency supplies by means of diesel generators, UPS and dc supplies as appropriate.
4. Achieve, to the maximum extent feasible/justifiable, standardization of equipment and favor maintainability and extendibility of the systems.
5. Include a consideration of the maximum number of LNG trains to be added in the future.



Electrical equipment for the project should be based on proven reliability, ease of operation, maintainability and cost effectiveness. However the use of synchronous motor drives with ratings of 40 to 100+MW are considered a feasible proposition and their deployment in LNG processes, with BP technical participation, is encouraged. Equipment having a limited track record will require specific approval, and suitable justification (cost, schedule, performance, technology risk) prior to application within the project.

The level of spares to be included for all major system components should be based on a trade-off between minimum whole-life cost of the project and maximum availability.

3. Description of the Process

Although there are more than two liquefaction processes, only the two most common basic generic processes for LNG plants are considered here.

The Cascade Process has three refrigerant services, propane, ethylene and methane (C3, C2 and C1 respectively). For a nominal LNG Train with a design production capacity of 4.5 mtpa, each refrigerant service requires approximately 80MW of compression. The total electrical demand of two LNG production trains of some 4.5 MTPA each, including process/utility loads of 20-30MW, is in the region of 400MW.

An example of a typical single line diagram for the basic electrical power system for one LNG Train of nominal production capacity of 4.5 MTPA of the Cascade process with two compressors for each refrigerant system is shown in Figure 1 (Cascade Process - Basic Electrical Configuration (1 Train)).

The Mixed Refrigerant process utilizes two refrigerant services, propane (C3) and a mixed refrigerant (MR). For single line refrigeration, motor ratings of 80-100MW are utilized. With process/utility loads accounting for a further 20-30MW, the total electrical demand of two trains of 4.5 MTPA each would be up to 330MW.

A typical single line diagram of the basic electrical power system for the Mixed Refrigerant process is shown in Figure 2, Mixed Refrigerant Process – Basic Electrical Configuration (1 Train). Although single line refrigeration configuration is shown for the Mixed Refrigerant process, it is possible to use two smaller motors operating in parallel for either of the LNG processes.

The loads and voltage levels shown in the diagrams are indicative only and would depend on the actual project under consideration. Both figures show the basic requirements for a single train only. For further trains, some sharing of process/utility supplies may be appropriate.

