LNG liquefaction plants

Mott MacDonald has delivered electrical networks for many of the world's major liquefied natural gas (LNG) production plants and possesses unrivalled expertise in this field, including:

- Design of power supplies for electric drive and non-electric drive LNG trains
- Performance assessment of islanded, floating and grid connected LNG plant systems
- Prime mover transient assessment – open cycle gas turbines (GTs), combined cycle gas turbine (CCGT) steam transients and controls
- Harmonics, fault levels, dynamics, switching transients, protection and general system expansion planning

We have been designing, modelling and assessing power systems for large petrochemical plants for decades. Our long heritage in engineering highly reliable power supplies for this sector has been utilised extensively for the LNG industry in recent years.

Providing either full design services or expert design advice, we work closely with clients to deliver cost effective LNG plant power systems designed with whole plant reliability and availability in mind.

The problems

LNG plants pose particular problems in electrical supply in both their grid connected and islanded forms. Electrically driven liquefaction trains (e-LNG) are stretching the requirement for reliable power. Partial electric drive versions – where a helper motor is used to support the GT driven compression train, or even to occasionally extract power from it – present their own design issues.

Reliability is the overriding issue in these plants. LNG shipments are contracted to strict timetables and power failure can jeopardise these, resulting in major financial loss.

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Photo: Woodside Energy

The drive to reduce compressor downtime has led to the advent of electric drive systems, making use of the high reliability of electrically driven motors. This in turn has greatly increased both the size and criticality of the power systems.

Delivering solutions

Since 1995 Mott MacDonald has been supporting both developers and major contractors to design and verify power systems for LNG plants. We have also been involved in a number of concept studies, particularly for electric drive versions of the plants and for plants where the variable speed drive (VSD) helper motors are reaching 40-60 MW.

Fully electrically driven compression systems result in each compression train demanding some 400 MW or more. Supply arrangements to provide this – taking into account a variety of technical issues such as supply availability, transient performance and harmonics – require the specialist electrical power design and analysis skills that Mott MacDonald excels in.

This expertise is based on many practical design studies and site measurements on major plants with partial electric drives, and extensive studies on the options for new e-LNG concepts and actual e-LNG plants as they move through the design process.

Our global track record in LNG plant power systems includes client facilities in:

- Australia
- Indonesia
- Iran
- Nigeria
- Oman
- Qatar
- Yemen
- Egypt

The role of modelling

Mott MacDonald has used modelling to asses the best CCGT configuration that would meet the transient acceptability required by an all electric LNG plant. The CCGT option has environmental and fuel cost advantages over the more usual open cycle n+1 or n+2 generation line ups. The impact of variations in steam header size and back up boiler capability were among several factors assessed.

LNG plant harmonics are key constraints that have to be managed at the design stage. Harmonic modelling can be done in the frequency domain or the time domain. The latter is more detailed and takes account of inter-harmonics, which can be an important feature with large VSDs.

Our modelling expertise has been put into effect around the world, including the LNG plant at Bonny Island in Nigeria. This was originally designed and installed as a two train plant but expanded to have six trains by 2008, and further developments are planned. Mott MacDonald has been involved in developing the power system from the outset, providing system modelling design guidance and protection setting expertise. Harmonic modelling has been a feature of project studies, complemented by harmonic measurements.

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