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Coastal Flood Protection for Liquefied Natural Gas Developments – Understanding Risks And Returns

COASTAL FLOOD PROTECTION FOR LIQUEFIED NATURAL GAS DEVELOPMENTS – UNDERSTANDING RISKS AND RETURNS

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Liquefied natural gas or LNG is natural gas with is primarily methane, CH_4, that has been converted to a liquid form for adequate storage or transport. In a typical LNG process the gas is first extracted from a deep offshore gas exploration site and transported to an onshore or near shore processing plant where it is purified by removing any condensates such as water, oil, mud, as well as other gases. An LNG process train will also typically be designed to remove trace amounts of mercury from the gas stream. The gas is then cooled down in stages until it is liquefied. LNG is finally stored in storage tanks till it is shipped to the other usage destinations.

Building a multi-billion dollar LNG processing and exporting plant is an elaborate process and requires a large suite of engineering and environmental site specific studies, some of them are summarized below:

- Soil and geotechnical survey that includes to define the geo-mechanical, geological and tectonic characteristics of the subsoil,
- Study of the land topography and bathymetry
- Study of land use and vegetation covers
- Groundwater tables,
- Sea water quality and temperature
- Tidal conditions,
- Shock waves and flooding (such as tsunami or failure of dams),
- Survey of the surrounding civil infrastructure (e.g., industrial sites, built up areas, communications).
- Study of the site meteorological and ocean conditions (prevailing wind direction, velocity and gust duration, and hurricane and tornado frequencies, maximum and minimum temperature data, relative humidity, rainfall (max, yearly and seasonal averages), snow loads and potential for freezing rain or ice buildup on equipment,
- Site elevation and standard atmospheric pressure, as well as the rate of change of barometric pressure.

Typically, LNG plants are constructed in remote areas at a proximity to a large water body (ocean, sea or gulf) connecting the gas fields offshore to an onshore terminal and facilities for gas processing, production and transport. Significant onshore and near shore infrastructure are typically constructed for LNG plants including a series of gas and liquid pipelines; processing trains and other facilities; storage tanks; dredging for access and navigational channels; marine berths; access and pipeline trestles; a near shore material off loading facility; loading and offloading ramps; coastal causeways for plant access and during construction; series of administration buildings and plant operation center, construction villages for staff living during construction and helicopter pads and airports.

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Investigating the coastal flooding risks and assessment of flood mitigation risks is always an integral part of an LNG site selection and construction process. Analysis of tsunami impact, cyclonic storm surges, rainfall and fluvial flooding for multiple storm conditions serve as a foundation to establish the base elevation for a plant site and the associated flood mitigation measures. The output of the coastal flooding analysis becomes a major cost and schedule contributing factor for the plant total construction value.

This paper will outline typical procedures and processes performed for coastal flooding analysis; guidance on setting storm recurrence intervals to specific parts of the LNG plant; quantifying risks of storm impacts relative to project design life; and guidance on selecting appropriate and cost effective flood mitigation measures for the LNG plant.

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