Potential Climate Risks to Oil & Gas Infra and Operations

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The recent IPCC report on climate change has once again emphasized on the risks we face by unmitigated climate change. Global instances of extreme climatic events show that the long-lasting economic impact takes the form of damage to infrastructure, and suspension of fundamental infrastructural services. The primary techno-economic transformation required to abate climate change relates to fossil fuel-based energy infrastructure. Fossil-fuel based energy infrastructure, therefore, is vulnerable, with or without climate action.

Various modeling studies examining energy sector transition options for low-carbon development pathways in India, prioritize the power sector, giving at least three decades of window to the oil and gas sector. However, the hydrocarbon sector is not immune to the impacts of global warming, even if the 2-Degree goal is achieved. Hence, the sector needs predictive planning. **In this article, we provide a preliminary assessment of the climate risks that the oil and gas sector in India is likely to be exposed to in coming decades.**

Climatic events fall in two categories: extreme events and slow onset events. Extreme events include occasionally intense events such as cyclones, storm surges, extreme rainfalls, etc. causing huge financial losses. Slow onset events include change in climatic conditions which will occur at a relatively much slower rate over a period of time, but will have sustained implications over a longer time period such as rise in ambient temperatures as well as sea surface temperature, sea-level rise, reduction in soil moisture, etc. While infrastructure is mostly vulnerable to extreme events, processes and operations are sensitive to slow onset events as well. The infrastructure of pipelines is also sensitive to soil moisture.

Based on PRECIS regional climate model simulations, and geographical spread of Oil & Gas infrastructure in India, following variations in the risk profile of various oil and gas infrastructure and operations are expected due to change in climatic patterns over India during 2020-2050 compared to the period 1970-2000:

Supply chain disruptions due to floods: Oil & Gas operations are sensitive to flooding. Impacts include full or partial shutdown of refineries, disruption in road-based supply chains, including road accidents, ruptures in pipelines, disrupted access to infrastructure for maintenance and repair, etc. Considering the projected change in annual rainfall and number of extreme rainfall days, together with past pattern of flood occurrences during 1985-2011, and possibility of exposure

to cyclones as contributing factors for extreme rainfall or flooding, an overall increase in exposure to flood risk across India is expected. The largest increase in impacts due to floods will be experienced in the north-western region, parts of north eastern and inland peninsula of India. **Figure 1** shows the increase of flood risk to the oil refineries.

Fresh water scarcity for refineries and petrochemical plants: Reduced fresh water availability can affect the throughput and cost of water. Depending upon the water intensity of a refinery or petrochemical plant, a 5% reduction in fresh water availability may result in corresponding decline in total throughput. The larger the plant capacity, the greater the risk. Considering the projected increase in number of dry days, and number of high temperature days together with drought intensity of past occurrences (1985-2011) and observed extraction to replenishment ratio during 1985-2011, water scarcity will increase more acutely in North-Western India compared to other regions. **Figure 2** shows the increase in water scarcity to oil refineries.

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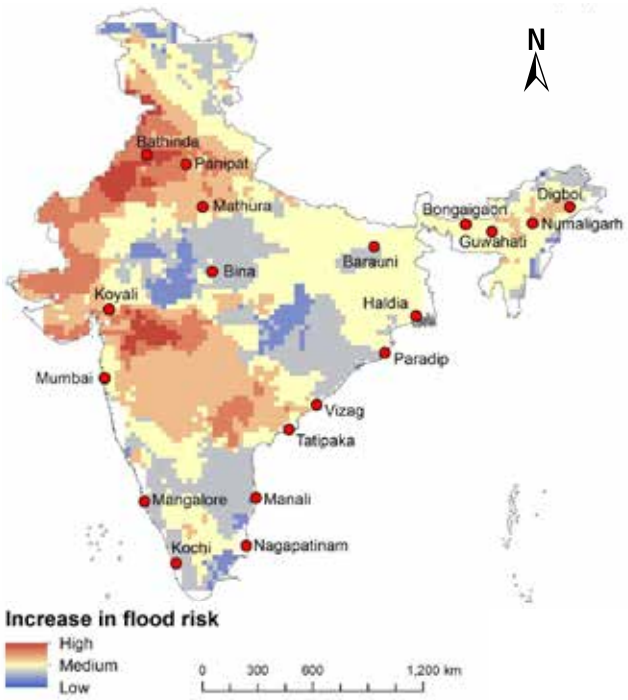
Figure 1: Increase in flood risk to oil refineries



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BY ADDRESSING THE
TOUGHEST CHALLENGES
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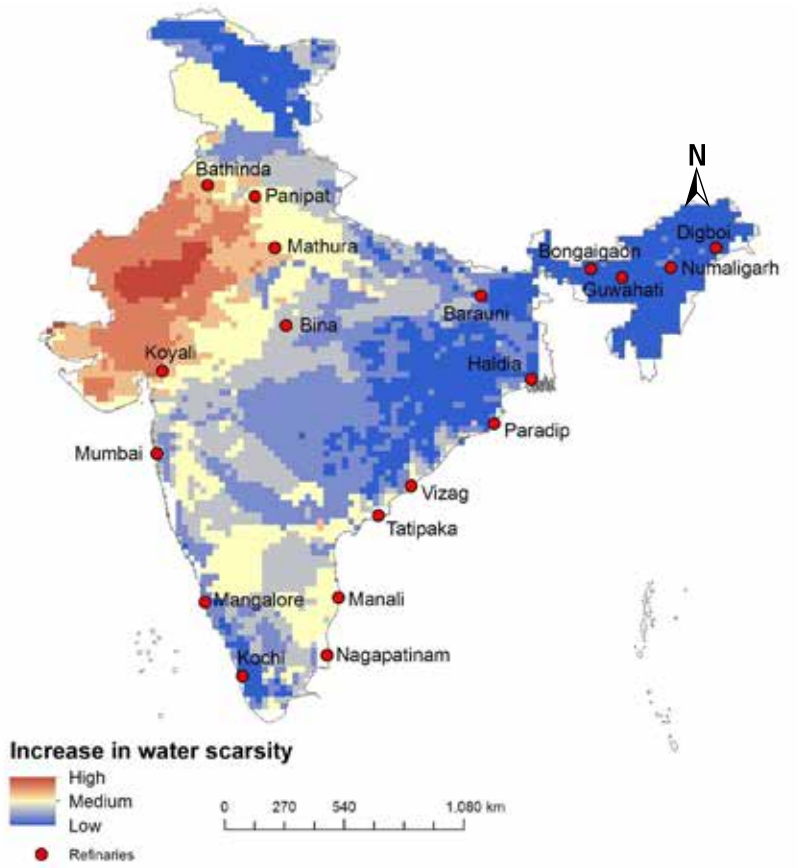
Figure 2: Increase in water scarsity to oil refineries



> Considering that India receives multiple shipments of LNG and LPG weekly, increased frequency and intensity of cyclones will cause greater disruptions in supply

Cyclone and storm surge risk to LNG/LPG terminals: The infrastructure on the east coast will be exposed to increased frequency and intensity of cyclones as well as storm surges due to the rise in sea surface temperature and rising sea levels. Considering that India receives multiple shipments of LNG and LPG weekly, increased frequency and intensity of cyclones will cause greater disruptions in supply. Rise in storm surge heights will pose even a greater risk of damages to Jetties, which may lead to additional costs of repair or rebuilding as well as prolonged delays or reduced capacity to receive imports.

Figure 3 shows the tracks of cyclonic storms and depressions over the Indian coastlines from 2001-2015 with locations of oil and gas assets.

Efficiency of cooling towers at refineries and petrochemical plants: Depending upon the design and capacity utilization of the cooling towers, rise in ambient air temperature may lead to increased water requirement and energy consumption or constraints on throughput. The increased frequency of five or more consecutive days with temperatures higher than 450C and increase in total number of extreme hot days will have significant impacts in the North West, North Central and Inland Peninsula regions of India. **Figure 4** shows the projected increase in consecutive hot days (defined as days with temperature >45 degrees Celsius) in future.

Figure 3:

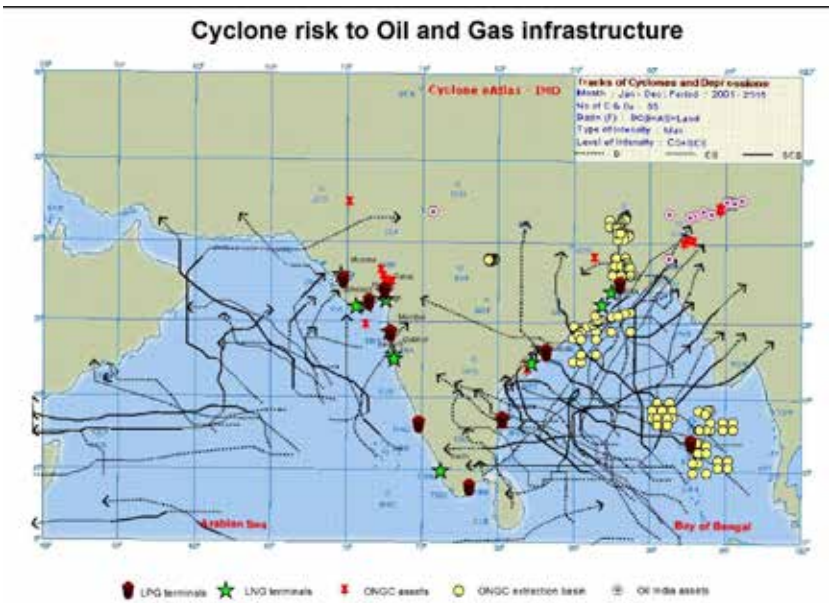
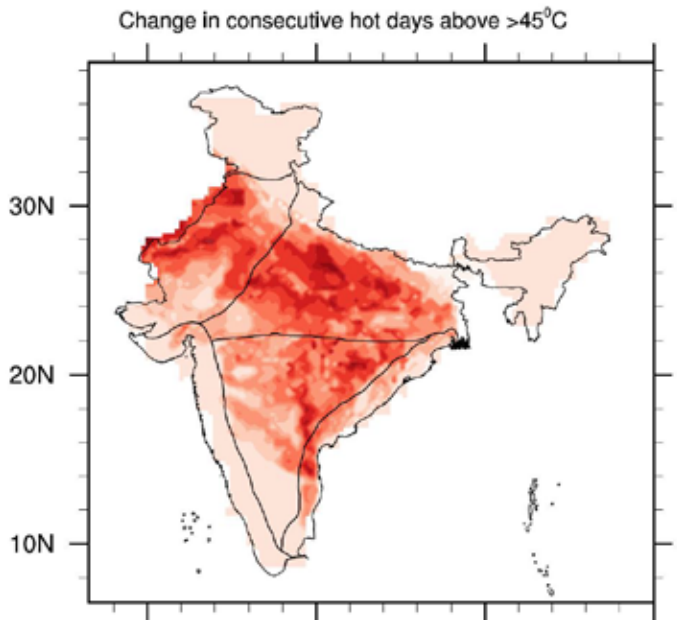


Figure 4: Future change in consecutive hot days (days having more than 45 degrees celcius) for 2020-2050 relative to 1970-2000



Flood risks to pipeline infrastructure: While most of the pipelines in India are underground, they are broadly immune to climate risks. The supporting infrastructure along the pipelines, however, will be more exposed to climate change. Pipelines may be more vulnerable where they cross a river in a high flood risk zone. Since the points of horizontal drilling on both sides of the river are only about 500-600 meters from the river banks, they are more vulnerable to exposure and scouring during floods, especially in cases where the rivers change course. This risk will be heightened in the North West and Inland Peninsula regions. **Figure 5 (a & b)** show the changes in flood risk for the future for the major pipelines in India.

Efficiency of gas processing units: The gas processing units recovering C2, C3, and C4 may experience reduced average productivity due to upward change in temperature conditions. In the absence of enough time series data on change in ambient air temperature, production from the fractionators, and energy consumption, any quantitative estimates could not be arrived at. The PRECIS model result show that average temperatures may rise by 20C over next 30 years with the maximum change being in North, Central, and North-West India.

Energy consumption at compressor stations and regasification plants: Energy consumption at the compressor stations vary according to the levels of ambient air temperature and humidity. Hence, increase in energy consumption with increase in ambient air temperature and humidity is expected in North West, North Central, and Inland Peninsula regions. The heat exchangers at the LNG regasification plants, however, are likely to benefit from rise in temperature in terms of both production rate as well as energy consumption.

Figure 5a: Changes in future flood risk for IOCL pipelines

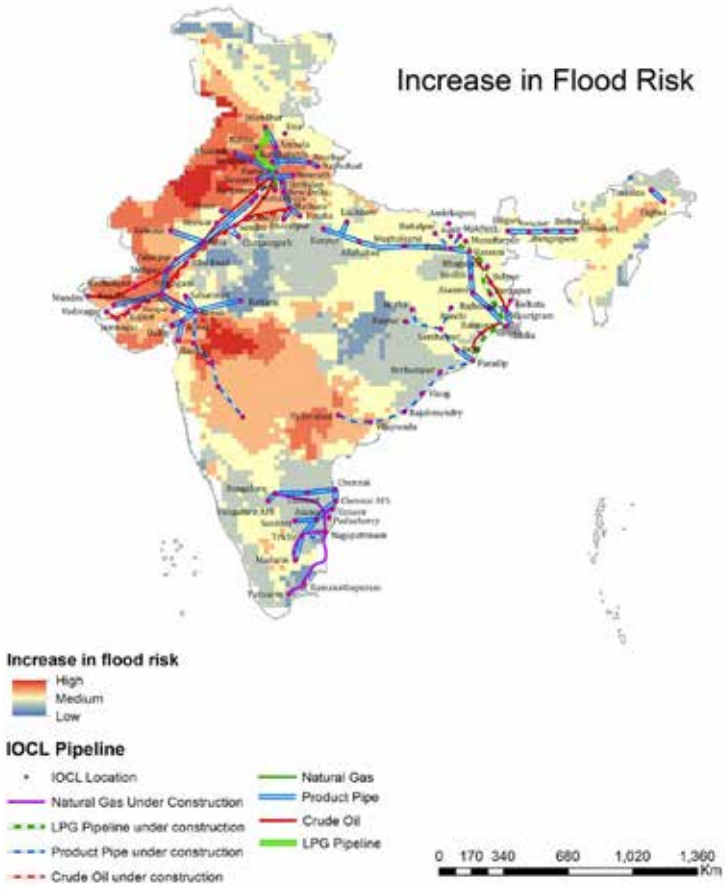
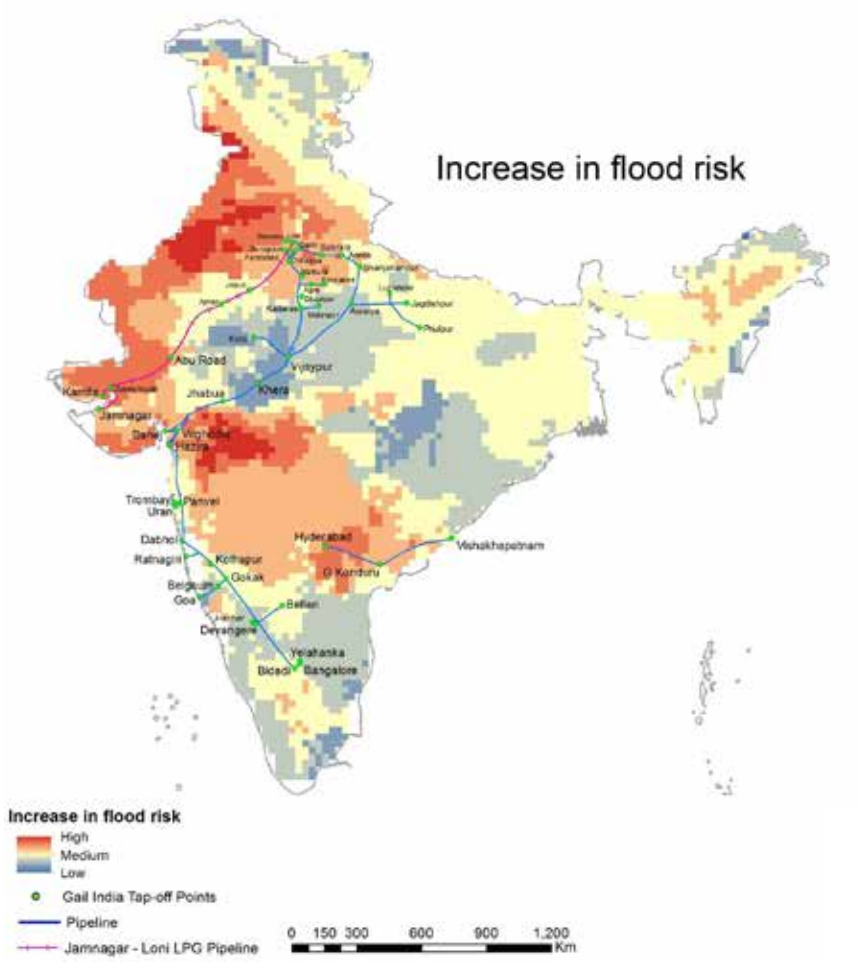


Figure 5b: Changes in future flood risk for GAIL pipelines



> It is highly recommended that companies having assets in high vulnerable zones in India should conduct location specific risk-modelling studies like high resolution flood-modelling risk analysis taking into account long-term precipitation projections

Conclusion

To sum up, the North-West and East Coast regions are expected to experience significant variations in multiple climatic parameters and events. These are also the regions where significant and diverse oil and gas infrastructure is concentrated. Hence, from the preparedness point of view, these regions should be treated as 'hot spots' for intervention. Considering that each plant and location is differently vulnerable to different climate risks, it is strongly recommended that at least large plants and infrastructure located in these regions are studied in greater micro-details. It is highly recommended that companies having assets in high vulnerable zones in India should conduct location specific risk-modelling studies like high resolution flood-modelling risk analysis taking into account long-term precipitation projections. The benefits of such an exercise would go beyond the companies and contribute to building climate resilience of the concerned region. For example, Trans Canada has implemented a number of measures to minimize the damage caused by extreme precipitation and cyclone events. The company has asset-specific teams that interpret, model, and manage physical risks with the commercial and engineering teams of each business. Apart from risks to extreme climate events, it is also recommended to explore plant/asset specific water efficiency improvement options given the future water scarcity risks over the Indian region. For example, StatOil develops water management plans based on projections of water availability six years into the future. In addition, a substantial portion of the research and development (R&D) budget worth NOK 3.0 billion is allocated for water management projects. Hence, it can be argued that the the sector is at a critical juncture where it needs to integrate climate change projections in its operations and planning in a holistic manner. While interpreting the predictions presented above, it must be kept in mind that these are preliminary macro-level assessments and the risk is not absolute, but variation over historical experiences.

The views in the article of the author are personal.

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