Managing Environmental and Social Issues Associated with the Design and Construction of Onshore Pipelines

IPLOCA Regional Meeting (East and Far East Region)

Kuala Lumpur, 2nd June, 2015
PRESENTATION OVERVIEW

- Introduction to AECOM
- Environmental and Social Issues and Challenges for Onshore Pipelines
- Good Practice Principles
- Case Study: Sakhalin II Phase 2 Project, Russia
- Closing Thoughts
- References
Who is AECOM?
AECOM

- 100K Employees
  - Nearly 100,000 dedicated professionals globally

- 150+ Countries
  - Serving clients in more than 150 countries around the world

- $19.5 Billion
  - Est. $19.5 billion in pro-forma revenue reported LTM ended Sept. 30, 2014

- Architecture
- Building Engineering
- Construction Services
- Design + Planning
- Economics
- Energy
- Environment
- Government
- Mining
- Oil & Gas
- Program, Cost Consultancy
- Program Management
- Transportation
- Water

Note figures include pro-forma estimates for URS and Hunt Construction Group.
CAPABILITIES FOR PIPELINE PROJECTS

Planning
- Prefeasibility studies
- Feasibility studies
- Geotechnical engineering
- Cost estimations

Implementation
- Route engineering
- Detailed design
- Procurement
- Contract documentation and specifications
- Construction management

Operations
- Operations and maintenance support
- Corrosion control
- Facilities Management
- Condition assessments and maintenance

- Health and safety
- Environmental management
- Project management
Environmental and Social Issues / Challenges for Onshore Pipelines
TYPICAL ENVIRONMENTAL AND SOCIAL ISSUES

- Land-take
- Biodiversity loss
- Cultural heritage
- Pollution control and Waste Management
- Disruption of livelihoods
- Community safety
- Traffic management
- Loss of remoteness
- Communicable diseases
- Employment and trade opportunities
- Use and management of dangerous substances

- Major hazards assessment and management
- Labour issues (including the four core labour standards), and occupational health and safety
- Fire prevention and safety
- Land acquisition and involuntary resettlement
- Impacts on affected communities, particularly disadvantaged or vulnerable groups
- Impacts on indigenous peoples, and their unique cultural systems and values
### Key Challenges

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed / Pace:</td>
<td>Pipelines are often conceived and completed within 24-36 months, so <strong>speed is a constraint</strong> to preventing impacts.</td>
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<tr>
<td>Early Assessment:</td>
<td>The pace of pipeline projects often means that <strong>environmental assessment</strong> must kick-off as soon as pre-feasibility planning begins.</td>
</tr>
<tr>
<td>Routes:</td>
<td><strong>Route selection</strong> is the best means for avoiding and minimizing environmental effects.</td>
</tr>
<tr>
<td>Distance:</td>
<td>Linear infrastructure that often <strong>covers great distances</strong> and therefore affects (and is affected by) different habitats and many communities.</td>
</tr>
<tr>
<td>Benefits vs. Risks:</td>
<td><strong>Perceived benefits</strong> accrue largely to people at either end, while the <strong>risks are borne</strong> mostly by communities adjacent to the corridor.</td>
</tr>
<tr>
<td>Transboundary:</td>
<td>Sometimes <strong>cross international boundaries</strong> with different environmental legislation, cultural norms and community expectations.</td>
</tr>
</tbody>
</table>
WHY BE CONCERNED?

– Pipelines can impact significantly on people and the environment because of either:
  - *Inadequate assessment*, or
  - *Failing to implement the assessment*.

– Overall goal is to enhance development effectiveness, save scarce resources, and protect vulnerable people.

– By designing out the more serious impacts of pipeline schemes, reducing any big risks, and mitigating the rest we’ll end up with safer and less controversial pipelines at greatly reduced overall cost.
Good Practice Principles
ENVIRONMENTAL IMPACT MITIGATION HIERARCHY

- AVOID
- REDUCE
- MINIMISE
- RESCUE
- TRANSLOCATE
- REPAIR
- RESTORE
- REINSTATE
- COMPENSATE

AVOIDANCE IS BEST ACHIEVED AT ROUTE SELECTION PHASE
GOOD PRACTICE – PLANNING PHASE

– Adopt a policy of legal compliance as a minimum (preferable to use international benchmarks such as IFC environmental & social performance standards)

– Strategic assessment of environmental effects of alternative means of market access for the product e.g. rail, road, ship?

– Route selection is the first and most effective means of preventing pipeline impacts from the outset
  • Involve environmental personnel in the route selection process
  • Choose a pipeline route that avoids the most environmentally and socially sensitive areas

– Early and meaningful engagement with stakeholders
GOOD PRACTICE – DESIGN PHASE

- Leverage learnings from the impact assessment and from stakeholder engagement

- Develop action plans and an environmental and social management system (ESMS) to provide the means to implement the ESHIA commitments

- For sensitive areas that cannot be avoided, utilize lower-impact techniques such as horizontal directional drilling (HDD)

- Reduce width of the corridor cleared for construction and minimize the time for which it is de-vegetated prior to reinstatement
GOOD PRACTICE – CONSTRUCTION PHASE

– Select the right contractors (with strong environmental track record), and if necessary drive the formation of construction JVs to leverage the skills of the companies

– Monitor environmental and social performance, and pro-actively address issues / non-compliances

– Contract structure needs incentives and penalties. Should include mandating performance bonds, escrowed accounts, effective monitoring and fines for non-compliance

– Assurance of sub-contractor environmental performance and compliance with contract requirements
Case Study: Sakhalin II Phase 2 Pipelines, Russian Federation
Phase 2 was commissioned in 2009 at an estimated cost of between USD20-30Bn (based on some estimates).
SAKHALIN ISLAND TOPOGRAPHY

Photo Credit: Sakhalin Energy Investment Company
## PIPELINE CHARACTERISTICS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SPECIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pipeline Diameter</strong></td>
<td>2 x 20 inch/500mm – oil and gas</td>
</tr>
<tr>
<td></td>
<td>1 x 24 inch/600mm – oil</td>
</tr>
<tr>
<td></td>
<td>1 x 48 inch/1200mm - gas</td>
</tr>
<tr>
<td><strong>Design Pressure</strong></td>
<td>100 bar</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td>171km – North area (upstream of OPF)</td>
</tr>
<tr>
<td></td>
<td>636km – main export</td>
</tr>
<tr>
<td></td>
<td>807km – Total length</td>
</tr>
<tr>
<td><strong>Buoyancy Control</strong></td>
<td>Saddles used at all flood plain and wetland crossings</td>
</tr>
<tr>
<td><strong>River Crossings</strong></td>
<td>1103 rivers, streams, canals and lakes</td>
</tr>
<tr>
<td></td>
<td>63 “sensitive” crossings</td>
</tr>
<tr>
<td></td>
<td>161 dry courses</td>
</tr>
<tr>
<td></td>
<td>486 brooks</td>
</tr>
<tr>
<td></td>
<td>8 ponds</td>
</tr>
<tr>
<td></td>
<td>251 irrigation canals</td>
</tr>
<tr>
<td></td>
<td>3 springs</td>
</tr>
<tr>
<td></td>
<td>86 small water courses</td>
</tr>
<tr>
<td></td>
<td>108 salmon rivers</td>
</tr>
<tr>
<td><strong>Pipe Bridges</strong></td>
<td>None</td>
</tr>
<tr>
<td><strong>HDD</strong></td>
<td>8 Rivers: Buyuklinka, Firsovka, Val, Tym (twice), Naiba, Nabil, Vasi</td>
</tr>
<tr>
<td><strong>Trenched Crossings</strong></td>
<td>Remainder</td>
</tr>
</tbody>
</table>

Source: TAPS & Sakhalin 2 Pipelines Comparison, SEIC 2003
<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>SPECIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welding</td>
<td>Field girth welds, all welds 100% x-rayed</td>
</tr>
<tr>
<td>Burial Depths</td>
<td>Minimum 1 metre cover.</td>
</tr>
<tr>
<td></td>
<td>Up to 10 metres cover at river crossings and flood plains.</td>
</tr>
<tr>
<td>Access Roads</td>
<td>3.5 metres wide (Class 5B)</td>
</tr>
<tr>
<td></td>
<td>Up to 350km of access roads required if all block valve stations to be fully</td>
</tr>
<tr>
<td></td>
<td>accessible by vehicle</td>
</tr>
<tr>
<td>PIG Facilities</td>
<td>5 – Situated at Piltun Landfall, Onshore Processing Facility, Booster Station</td>
</tr>
<tr>
<td></td>
<td>2, LNG plant and Oil Export Terminal.</td>
</tr>
<tr>
<td>Pumping Stations</td>
<td>Oil – 1 at OPF and 1 at OET</td>
</tr>
<tr>
<td></td>
<td>Gas – 1 at OPF and 1 at Booster Station 2</td>
</tr>
<tr>
<td>Pipeline Valves</td>
<td>All ball valves</td>
</tr>
<tr>
<td></td>
<td>Oil – 107</td>
</tr>
<tr>
<td></td>
<td>Gas – 43</td>
</tr>
<tr>
<td></td>
<td>All 150 remotely controlled</td>
</tr>
</tbody>
</table>

Source: TAPS & Sakhalin 2 Pipelines Comparison, SEIC 2003
## PIPELINE CHARACTERISTICS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SPECIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seismic Crossings</td>
<td>Buried using custom trench design and backfill.</td>
</tr>
<tr>
<td></td>
<td>Strain-based design methodology.</td>
</tr>
<tr>
<td></td>
<td>Insulated foam blocks to absorb movement.</td>
</tr>
<tr>
<td></td>
<td>Water exclusion and trench drainage.</td>
</tr>
<tr>
<td>Earthquake Design</td>
<td>Safe Level Earthquake – 200 year return</td>
</tr>
<tr>
<td></td>
<td>Design Level Earthquake – 1000 year return</td>
</tr>
<tr>
<td>Faults Crossed</td>
<td>19</td>
</tr>
<tr>
<td>Earthquake Monitoring</td>
<td>Strain monitoring spools in pipeline at fault crossings communicating strain</td>
</tr>
<tr>
<td></td>
<td>levels via SCADA to central control room.</td>
</tr>
<tr>
<td>Leak Detection</td>
<td>Statistical mass balance sensitive to &lt;1% flow rate.</td>
</tr>
<tr>
<td>Communications</td>
<td>Primary: fibre optic cable</td>
</tr>
<tr>
<td></td>
<td>Back-up: satellite</td>
</tr>
<tr>
<td></td>
<td>Control systems for SCADA, telemetry, seismic monitoring, gate valve</td>
</tr>
<tr>
<td></td>
<td>status monitoring and control.</td>
</tr>
</tbody>
</table>

Source: TAPS & Sakhalin 2 Pipelines Comparison, SEIC 2003
- Russian Federation (RF) government was seeking to acquire a majority shareholding in the project.

- An ESHIA was completed – however was deemed to not be “fit for purpose” by European Bank for Reconstruction and Development (EBRD); lenders postponed financing decision until issues were remedied

- Sakhalin Energy Investment Corporation (SEIC) decided to undertaken further environmental (and social) assessment work and an “EIA Addendum” document was issued to supplement the original ESHIA

- Throughout this time construction was ongoing and there were recurrent violations of RF environmental regulations and IFC policies as well as a failure to observe good environmental practice

- Intense schedule pressure and construction often ran ahead of the environmental assessment and implementation thereof
CONSIDERATION OF ALTERNATIVES

- Four (4) feasible design alternatives were initially evaluated:
  1. A pipeline running from east to west across the island to the Russian mainland
  2. An onshore pipeline system for the Piltun field and a predominantly offshore pipeline system for the Lunskoye field
  3. A totally offshore pipeline system
  4. A predominantly onshore pipeline system

- **Option 4** was ultimately selected.
CONSIDERATION OF ALTERNATIVES

Sea ice in the Sea of Okhotsk:

Photo Credit: Sakhalin Energy Investment Company
• The onshore pipeline alignment was chosen to shadow the route of the island’s existing north-south road and railway line;

• The offshore pipelines route selection was a more challenging process:-
  • Western Grey Whale summer feeding grounds
  • Migratory bird summer feeding grounds
Western Grey Whale issue was managed by establishing an Independent Scientific Review Panel under the auspices of the IUCN.

Impact mitigation measures included:
- Re-routing of the offshore pipelines to by-pass the near-shore summer feeding grounds and make landfall 20km to the south (blue line);
- Undertake pipe-lay activities in winter; and
- Use HDD to lay the pipe in the near shore area.
Local Content requirements stipulated in the Production Sharing Agreement

Construction contract was awarded to a joint venture between Saipem and Starstroii - a union that was short-lived

Sakhalin Energy had to take the commercial reins and change onshore pipelines construction contract from lump sum to cost reimbursable

The entire 800km Right of Way was cleared of all vegetation in a few months at the beginning of construction

Sakhalin Energy pipelines management team had to contend with contractor construction quality (and environmental) control issues

Environmental non-compliances were a highly visible and headline grabbing side-show

Contractor management proved to be a critical issue with environmental implications
As many as 63 of the 1103 river crossings contained wild salmon spawning grounds. Wild salmon is an important component of local economy as well as Nivkh people’s heritage.

The local Sakhalin Tiamen salmonid is a Red Data Book listed species and a scientific monitoring study was commissioned.

Wet trenching was selected for all but 8 rivers crossings (used HDD) because of perceived risk of sabotage – as well as cost factors.

SEIC developed and implemented a River Crossing Strategy which included:
- Method statements for wet trenching of sensitive river crossings
- Construction across sensitive rivers only in winter
- Employed specialist environmental advisers to be part of the construction supervision teams
- Detailed winter river crossings monitoring and environmental compliance audit checklists
- Audit results published on SEIC website
- Appointed Independent Observers/Monitors to verify activities
Preparatory earthworks adjacent to river crossing:

Photo Credits: Mark Agar
Crossing of wild salmon river using HDD method:

Photo Credits: Mark Agar
Sakhalin Island is a very active seismic zone, e.g. 7.2 magnitude Neftegorsk earthquake in 1995, killed 2000 people.

Two main faults (Goromay and Khuchevskoi) and the pipelines run parallel with the latter.

Due to constraints from settlements, existing roads and utility corridors, there are 19 fault crossings.

The design level earthquake (DLE) has a return period of 1,000 years and a net displacement of up to 4.6m.

Three different special trench types were designed for the 19 fault crossings.
Main special trench elements include:
- Two trench geometries (narrow and large) based on stress analysis;
- A backfill material of either clean sand or expanded clay – also based on stress analysis;
- Membranes to exclude (or drains to allow free draining of) water ingress to prevent freezing that would alter mechanical properties of the special fill material; and
- Foam slabs on top of the pipelines to facilitate thermal equilibrium in the trenches.

Aim of design is to ensure pipeline integrity up to a DLE event (1 in 1,000 years versus 30 year pipe life)
CROSSING OF SEISMIC FAULTS

Special trenches for seismic fault crossings:

Photo Credits: Pierpaolo Mattiozzi and Alexander Strom
Closing Thoughts
Many of a pipeline project’s environmental and social risks are usually **beyond the control of the contractor**: 

- Route Selection
- The quality of the environmental assessment
- The pipeline developer’s relationship with host government, regulators, lenders, NGO’s and public
- What is deemed to be an “acceptable” level of risk is a value judgment and so it is a point of contention
- Outrage from the wider public (which may be misdirected) regarding perceived operations phase risks (leaks, fires and explosions) and indirect impacts (e.g. climate change) – issues which the contractor is often not responsible for
However there are some things contractors can do to actively manage the risks……

- Understand the environmental and social issues of the selected route, (including site-specific issues)
- Understand the ESHIA and related implementation plans, and your role in implementing them, and provide appropriate resourcing for implementation
- Develop a management system for implementing ESHIA commitments which includes regular monitoring / auditing
- Reduce unavoidable construction-related environmental impacts by:
  - Implementing your ESMS and associated management plans
  - Only working within agreed areas – sticking to the designated construction envelope
  - Develop construction method statements with impact mitigation measures and stick to them
  - Minimize nuisance and inconvenience to affected communities
  - Good “house-keeping” at site and in camps - appearances are important

TAKE HOME MESSAGES
Thank You

Questions / Comments?
REFERENCES


– Steven Marlborough, personal communication, 2015

– Imogen Crawford, personal communication, 2015