Table 3. Predicted $P_{90}$, $P_{50}$ and $P_{10}$ sales gas production profiles.
9. WELL DESIGN AND STIMULATION
10. SUBSEA LAYOUT

At the time the draft Plan was prepared it was anticipated that a fifth well would be drilled in 2001, with a probable top reservoir location in the southern part of the field. It was further recognised that such a well could be drilled either as a vertical well from a surface location in Block 18/25 or as an 'S-shaped' well from a surface location adjacent to the manifold location, near well 18/20-2z (Section 4.1.3.2).

A southern well (18/25-3) was drilled in 2001. Well 18/25-3 was drilled as a vertical well from a surface location about 2 km south of the manifold location. This option was chosen as

a) It would be simpler logistically to test the merits of fracture stimulation on a vertical well

and

b) The cost of drilling a vertical well and tying it back to the manifold was comparable to that of drilling a S-shaped well.

Well 18/25-3 has been suspended and it is intended it will be re-entered and completed as a producer, being tied back to the manifold. To minimise the amount of pipeline installed on the sea bed it is intended that well 18/25-1 will be tied back to well 18/25-3 and the two wells then tied back using a single pipeline to the manifold (Figure 8).
11. LOCATION AND CONFIGURATION OF FUTURE WELLS
12. WATER AND GAS COMPOSITION

Formation water

In well 18/25-3, for the first time, a sample of formation water was recovered from the Corrib reservoir. Provisional analysis of this sample demonstrates that Corrib formation water:

- Is highly saline – about 206,000 ppm NaCl equivalent. (Based on the analysis of a sample of formation water from well 27/5-1, it had previously been thought probable that the salinity of Corrib formation water was considerably less than this. However the possibility of high salinities was recognised and taken into account when selecting equipment for the water treatment facilities proposed for the Terminal.)
- Contains only very low concentrations of mercury – about 0.16 µg/litre or 0.00016 ppm.
- Contains only low levels of radioactive elements – about 0.043 Bq/g.

The PAD has been provided with a full analysis of the formation water sample obtained from well 18/25-3.

In summary, the composition of the formation water, as reported from analysis of this sample, and particularly with respect to mercury, lies well within the range assumed when the Environmental Impact Study for the Terminal was prepared and supports the conclusions drawn therein.

Water of condensation

No information on water of condensation was obtained from well 18/25-3 due to the high volumes of fracturing fluids (brine and broken polymer) recovered when the well was tested.

Gas

Analyses of gas from wells 18/20-1, 18/20-2z, 18/20-3, 18/20-4 and 18/25-1 were given in the draft Plan (Table 3.12). However it was not made clear in the draft Plan that the sample from well 18/20-2z was probably contaminated in the rig separator, the separator having been contaminated during a test on a previous field. The high recorded value for mercury in well 18/20-2z is, almost certainly, erroneous.

The most reliable measurements of mercury levels in the Corrib gas are those from wells 18/20-4, 18/25-1 and 18/25-3. In well 18/25-3 the analyses were made using gold leaf analysis on the rig, a particularly accurate and reliable method. The analyses from 18/25-3 indicate that the level of mercury in the Corrib gas is low (about 3.6 ng/litre), consistent with the samples from other wells (18/20-4 and 18/25-1).

Analysis of gas from well 18/25-3 indicates that the concentration of radon is also low – about 245 Bq/m³, comparable with the levels recorded on other wells (e.g. 18/20-3).
No measurement for mercury was made on the gas from well 18/20-1 (MDT sample only) and that from wells 18/20-2z and 18/20-3 was contaminated.
13. IMPACT OF THE CORRIB DEVELOPMENT ON IRELAND

THE IRISH GAS MARKET

Demand

The Irish gas market is relatively small. However, Ireland's demand for natural gas is expanding rapidly with total annual gas demand forecast to rise from 4.2 billion cubic metres (bcm) (148 billion cubic feet (bcf)) in 2001 to 6 bcm (211 bcf) in 2005 (Figure 9). The projected increase in demand is principally due to the increasing use of gas-fired power generation to meet the rapidly growing demand for electricity. Currently, some 25% of Ireland's electricity is generated from gas. Gas demand from this sector is expected to increase from 5.5 million cubic metres per day in 1998 to over 12.5 million cubic metres per day in 2010.

At the same time, Ireland's sole source of indigenous gas from Kinsale is in decline and imports are growing in importance. In 1998 50% of Ireland's gas needs were met by imports. That percentage is obviously increasing as demand increases and production from the Kinsale Field declines.

The markets for gas and electricity in Ireland have yet to be fully liberalised. Government policy on how these markets will operate has not yet been determined in detail. However the Government has stated that it aims to open both the electricity and gas markets to full supply competition by 2005. Whilst today the eligibility thresholds for supply competition is 9 million therms per annum, it is likely to be reduced to 0.8 million therms per annum in February 2002. Such a relaxation would permit all but the smallest commercial and industrial consumers and domestic customers to buy gas from any licensed supplier.

Demand for gas for power generation is expected to grow to meet the increase in demand for electricity and when other less environmentally acceptable fuels are phased out. The electricity market in Ireland was partially opened to the first stage of competition in February 2000. Whilst a number of gas-fired independent power stations may thereafter be brought on stream, it is unlikely that there will be a large number of new entrants until the future regulatory environment and the trading arrangements for electricity are known.

In addition to the power generation market, organic growth in the demand for energy in Ireland in other areas is anticipated to continue rising (Figure 9).

Supply of gas from Corrib

Commercial gas production from the Corrib Field is expected to commence in 2003 and to continue for between fifteen and twenty years (Figure 9). It is expected that the Corrib Field will supply in excess of 50% of Ireland's gas needs over the first three years of production and some 30% over the first ten years of production.

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8 Supply and demand data supplied by DKM Economic Consultants Ltd.
Additional potential production is provided in the Corrib area, as described in Section 14 of the Plan. The development of these prospects is dependent upon the Corrib Field first being developed.

**Diversity / security of supply**

In 1999 Ireland imported in excess of 85% of its energy requirements. Taking into account the need to reduce emissions and hence the need to switch from the consumption of coal and peat to clean fuels such as natural gas, Ireland's reliance on gas is set to increase. Unless Corrib is developed, all this gas will be imported from or via the UK.

However the UK will itself become a net importer of gas within the next few years and will become increasingly dependent on imported gas during this decade, such imports coming primarily from Norway and the Former Soviet Union (FSU).

Ireland is on the fringes of western Europe, and lies at the end of an extensive gas distribution system. Unless Corrib is developed, Ireland will be:

- Increasingly dependent for its gas supply on a country which is itself a net importer of gas, and
- Exposed to potential price / supply shocks in Norway or the FSU.

Development of an indigenous source of natural gas will therefore significantly increase Ireland's diversity and security of supply. Furthermore, encouragement of future exploration and appraisal activity will increase the likelihood of the further indigenous sources being discovered and developed. The availability of an indigenous gas supply will also partly offset Ireland's exposure to OPEC-driven changes in the price of oil.

**NATIONAL INFRASTRUCTURE**

At present there is no gas supply to the west and north west of Ireland and the electricity generation and supply system is under pressure in terms of demand. The national electricity grid based on 220 kV transmission does not extend westward beyond Flagford. Companies cite the lack of resilience in the network and the restriction to 110 kV supply as a deterrent to locating in the region.

Government policy, through prioritisation of the BMW (Border, Midland and Western) region, has acknowledged that this region currently enjoys restricted prospects for economic development. Expansion and reinforcement of the existing energy infrastructure is therefore required if business is to be attracted to the region. The Government also wishes to deliver gas to towns and centres in the west and northwest of Ireland.

The development of the Corrib Field, the construction of the related BGE gas pipeline from the terminal to Galway and the expansion of the Irish gas ring main system will provide a gas supply to a significant area of western Ireland and will greatly facilitate the further expansion of the gas network. Cities and towns which lie close to the Dublin-Galway Ring Main or the Mayo-Galway pipeline and could therefore be readily supplied with gas, include Athlone, Ballinasloe, Galway, Castlebar, Tuam, Loughrea, Athenry, and Claremorris. Other towns
and cities can also be considered for supplies, even though they are further from the planned new lines. These include Ballina, Sligo, Longford and Westport.

In addition, the availability of gas will result in the construction of new electricity generation capacity in western Ireland. An early example is the recently proposed conversion of the Beliacorrick power station from peat to natural gas. This will provide a strong incentive to improve the transmission grid.

Overall, the development of the Corrib field will:
- Enhance the attractiveness of the west and northwest for economic development
- Expand fuel choice for existing consumers, and
- Complement the Government's regional development strategy.

TAX RECEIPTS

The three co-venturers involved in the proposed development of the Corrib Field will each pay Irish corporation tax at a rate of 25%, double the rate currently payable by other businesses.

BALANCE OF PAYMENTS

Gas from the Corrib field will improve Ireland's balance of trade by approximately IRE2 thousand million at current prices over the life of field. Furthermore as the EU imports much of its gas, the EU and the Euro currency will benefit directly from the development of internal sources.

PROMOTION OF EXPLORATION AND APPRAISAL ACTIVITY

Ireland competes with the rest of the world for exploration funds but has a very poor record of exploration success with only a small number of discoveries, despite the drilling of considerably more than one hundred exploration and appraisal wells. To date, the Kinsale and Ballycotton gas fields are the only fields to have been developed. Further, the offshore west of Ireland is a harsh environment in which to operate, increasing the cost of exploration and development activities. Ireland therefore faces a significant challenge in attracting and maintaining a reasonable level of exploration activity. Development of the Corrib Field will demonstrate that Ireland is a place in which oil or gas can be found in commercial quantities and developed successfully.

EMPLOYMENT

Construction and installation

Two major engineering, procurement and construction (EPC) contracts have been awarded in relation to the subsea equipment while a third has been awarded for the construction of the terminal.
The first of the subsea EPC contracts covers the manufacture and installation of the subsea hardware (Christmas trees, manifold and electro-hydraulic control system) while the second covers the design, fabrication and installation of the subsea umbilical and pipeline from the field to the terminal.

The subsea hardware contract has been awarded to ABB Offshore Systems Limited while the marine and subsea installation contract has been awarded to Allseas Construction Contractors SA. The award of these contracts to large European integrated companies was almost inevitable as manufacture and installation of the subsea facilities requires specialist expertise and experience and the use of specialist vessels and equipment. There are no suppliers of such services in Ireland and only a limited number worldwide, due to the highly specialised nature of the market. However, there will be opportunities for some sub-contracted services, particularly in the area of logistics, transport, port services, plant hire and, possibly in steel fabrication or supplies. Further, construction of the onshore section of pipeline and umbilical from the landfall to the terminal will involve conventional civil engineering techniques and local Irish contractors will be involved in this activity as subcontractors to the main contractor. Currently, two large Irish companies have been awarded contracts - Pierce Contracting for onshore civil works and MC O'Sullivan for Engineering Services. Construction of the onshore pipeline, landfall and associated works will involve a peak labour force of around eighty to one hundred, many of whom will be local civil engineering operatives, plant hire operators and the like.

The terminal construction contract has been awarded to the ASI Corrib Joint Venture. This is a joint and several, equal-thirds joint venture formed to carry out the design, procurement, fabrication, construction and commissioning of the terminal. The companies forming the joint venture are Amec, who are responsible for the design, procurement and overall project and construction management, SIAC, who are responsible for site preparation, civil and structural works and Irish Industrial Fabricators (IIF), who will carry out all mechanical, electrical and instrumentation fabrication and construction. Amec is an international company based in the UK. SIAC, with offices in Dublin and Tuam, and IIF, with offices and fabrication facilities in Cork, are both Irish.

Construction activities at the terminal site will require a labour force of about 500 personnel. The personnel profile required for the construction phase of the terminal and associated upstream pipeline has been estimated as follows:

<table>
<thead>
<tr>
<th>Period</th>
<th>Approximate number of people</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 2002 to April 2002</td>
<td>100</td>
</tr>
<tr>
<td>May 2002 to August 2002</td>
<td>300</td>
</tr>
<tr>
<td>September 2002 to May 2003</td>
<td>Up to 500</td>
</tr>
<tr>
<td>June 2003 to October 2003</td>
<td>200</td>
</tr>
</tbody>
</table>

In addition to the above, a substantial level of ancillary services will also be required to support the construction team. Opportunities will arise in catering, accommodation, local transport, plant hire and security.
Other Construction

Construction of the BGE owned and operated pipeline from the terminal to Galway will provide a large number of additional jobs. This pipeline will be owned, constructed and operated by BGE, which has recently stated that more than 300 people will be employed during the construction of the pipeline.

Field Operation

During operations, a workforce of about 60 people will be employed. Many of these positions will require that personnel be trained to a high skill level. This will present opportunities for locally based people to secure long-term employment and to attain skills that are readily marketable throughout the EU and beyond.

The terminal will be manned 24 hours a day, operating primarily on an 8-hour shift basis. It is envisaged that most of the terminal operation including maintenance, service activities and administration will be carried out during the day shift period and that night shift work will primarily consist of a process supervisory nature with some additional minor maintenance tasks being undertaken.

A significant number of ancillary services will be required in support of terminal operations – these may include catering, landscaping, office supplies, I.T. support, printing services, maintenance and repairs, transport and logistics, security, plant modification works and so on. Most of these services will be procured locally, if they are available, and will involve a significant amount of secondary employment by existing or new service providers. Economic studies, such as that carried out by UCC for IOOA in 1999, demonstrate that the ‘multiplier’ effect leads to significant employment and expenditure outside of the parent industry.

OTHER

The impact on local infrastructure and on other users of the marine environment in the Corrib area is addressed in Section 13 of the draft Plan of Development. The social impact of the development on the Erris area is addressed in the Environmental Impact Statement which accompanies the Plan of Development.

However one point that is not mentioned in the draft Plan of 5th December is as follows. As a direct result of the construction of the terminal and its need for a piped drinking water supply, Mayo County Council will be initiating its long range plan to extend potable water distribution to the east of the treatment facilities at Carrowmore Lake. This will provide long term benefits to the local community.

[Note: Further information on page 48]

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Figure 1  

a) Location of the Corrib Field and Licences 2/93 and 3/94  
b) Location of wells drilled on the Corrib Field and the area of Petroleum Lease
Figure 5  Graph of gas flowrate and wellhead flowing pressure against time, post-frac test, well 18/25-3
Figure 7

a) Graph of gas flowrate against time, post-frac test, well 18/25-3

b) Extrapolation of gas flowrate with time, post frac test, well 18/25-3
Figure 9  Graph showing anticipated Irish gas demand (yellow), indicative forecast gas supply from Kinsale Head (blue) and P50 forecast from Corrib (green)