

ANNEX 12 – ENERGY SECTOR

A. Introduction

1. ***Overview of the energy sector in the earthquake affected areas.*** The energy sector in the affected areas consists of four subsectors: (i) the power sector; (ii) the petroleum sector; (iii) the natural gas sector; and (iv) subsistence fuels (wood and dried dung). This damage assessment focuses on the first three subsectors and provides separate descriptions of the power sector and the fuels (petroleum, LPG, and natural gas) sector.

2. Through the guidance and leadership of the Ministry of Water and Power (MOWP) and the Ministry of Petroleum and Natural Resources (MPNR) information was gathered from the involved agencies in the power sector¹ and in the petroleum sector², as well as from visits to the affected areas. Furthermore, the World Bank/ADB energy assessment team interacted directly with senior staff from the affected companies in the power sector through meetings conducted in Islamabad.

3. The agencies involved have physically inspected their respective power and fuels systems. IESCO and PESCO have been able to inspect both the 132kv system and distribution system, although it should be noted that about 40 percent of the affected area within the AJK electricity system has not yet been surveyed as access to these areas is still very limited. These areas are primarily rural areas, while all the highly populated areas have been inspected. In terms of the fuels sector field staff of the oil companies have inspected most of the facilities and provided direct input to the assessment.

B. Power Sector

4. ***Pre-earthquake status of the power system.*** Responsibilities for the supply of electricity in the affected areas is shared by a number of agencies/utilities.

Azad Jammu and Kashmir

- Electricity Department of Azad Kashmir (AJKED) is responsible for distributing electricity in AJK – including the affected districts (Muzaffarabad, Bagh and Rawalakot). It purchases electricity in bulk from two distribution companies (Islamabad Electricity Supply Company (IESCO) in the southern parts of AJK, and from Peshawar Electricity Supply Company (PESCO) in the northern portions). AJKED constructs and operates the distribution networks (11 kV and 0.44 kV), provides consumer connections, and manages the billing, collection and other operational matters. Prior to the earthquake, AJKED served about 363,000 consumers, of which 323,000 were residential, about 38,000 were commercial, and 1,800 were industrial consumers.
- IESCO manages the Secondary Transmission and Grid (STG) network in the southern part of AJK – this includes one 132 kV line and grid station (Rawalakot) and two 33 kV grid stations (Bagh and Hajeera).

¹ The involved agencies in the power sector are the AJK Electricity Department, Islamabad Electricity Supply Company (IESCO), Peshawar Electric Supply Company (PESCO), Sarhad Hydro Development Organization (SHYDO), and Water and Power Development Authority Hydel Section (WAPDA Hydel)

² The involved agencies in the petroleum sector are SHELL, PSO, Caltex, and a number of retail LPG entities.

- PESCO manages the STG network in the northern parts of AJK – this includes 132 kV lines and grid stations serving Muzaffarabad, and 33 kV lines and grid stations serving Hattian and Nauseri.

NWFP

- PESCO has full responsibility for electricity distribution in the affected districts of NWFP (Abbottabad, Mansehra, Barragram, Kohistan and Besham). It manages both the STG and distribution (11 kV and 0.44 kV) networks, provides consumer connections, and handles billing, collection and other operational matters. Prior to the earthquake, the average monthly demand for electricity in the two circles of PESCO which were impacted (Abbottabad and Mansehra) by the tremors was about 48 million kWh.

B.1 Damage Overview and Recovery Needs

5. The main components of the power sector which were impacted by the earthquake are the secondary transmission (STG) and distribution systems in AJK and the Northern Areas; a number of small hydropower stations were also affected. The quantum of damages in the power sector (i.e. excluding the cost of providing electricity to tent villages, new housing developments, etc.) is estimated at about Rs 642 million.³ These estimates (see Table 1) have been prepared by;

- **Electricity Department of AJK (AJKED)** for the distribution network and four hydro generation sites (capacity about 35 MW) in AJK;
- **Sarhad Hydro Development Organization (SHYDO)** for five mini/micro hydro generation units in the Mansehra and Kohistan district, which are owned by Shydo;
- **Peshawar and Islamabad Electricity Supply Companies (PESCO and IESCO)**. PESCO's estimate covers STG and distribution systems in the Northern Areas, while IESCO's numbers refer to STG networks in AJK which are owned and operated by IESCO; and
- **WAPDA**. for the approach roads and preparatory works of the Allai Khawar Hydropower Project – being constructed by WAPDA in Kohistan district.

Table 1: Overview of Damage

| Region/Implementing Agency | Damage (Rs. Million) | Description of Damage |
|-----------------------------------|-----------------------------|--|
| AJK | 222.5 | Distribution System, including Consumer connections; some small/micro hydro plants |
| IESCO | 35.0 | STG network, 3 districts of AJK – primarily buildings/civil works; some equipment was also destroyed when buildings collapsed |
| PESCO | 333.6 | Extensive damage to Distribution System and STG network in five districts (Abbottabad, Mansehra, Batagram, Kohistan and Besham) of NWFP |
| SHYDO | 24.3 | Civil works at four small hydro stations have been damaged |
| WAPDA | 26.4 | Approach roads and other preparatory civil works of Allai Khawar hydro power project, which is being constructed in Besham district, were extensively damaged. |
| Total | 641.8 | |

³ In case of AJK, about 40% of the area where electricity is supplied is still not accessible, and therefore has not yet been surveyed. These numbers do not include the cost of damage to infrastructure in those areas.

These estimates are based on recent quotations received or contracts awarded by the utilities for the same or similar equipment and their latest estimates of civil works costs. The civil works cost estimate (Rs. 1,200/Sq foot) has been escalated, to account for these buildings to be designed to higher specifications, and to comply with applicable building codes for earthquake resistance.

6. **Categories of damage.** Five agencies are responsible for power generation, transmission, and distribution in the affected areas, and the principal for the rehabilitation and reconstruction of the power sector is that these agencies will be responsible for their respective functions and geographic areas. The table below indicates the damage by item and responsible agency, as well as the aggregate total damage.

**Table 2: Damage by Implementing Agency and Functional Area
(Rs. million)**

| | PESCO | AJKED | IESCO | SHYDO | WAPDA | Total |
|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| STG | 234 | | 35 | | | 269 |
| Distribution | 100 | 173.0 | | | | 322 |
| Hydro Plants | | 49.6 | | 24 | 26.4 | 100 |
| Total | 334 | 224.6 | 35 | 24 | 26.4 | 642 |

7. Regarding hydro sites, powerhouse equipment was damaged in one station (Kathai) in AJK. At the other stations, the damage is confined to civil works including approach roads, intake structures, forebay and penstocks. Overall damage is estimated at Rs. 100 million, of which the largest amount, Rs. 26.4 million, is for approach roads (including bridges and culverts, retaining structures, etc) and other preparatory works of Allai Khawar project.

8. In case of STG, a major component of the cost covers equipment which was damaged or destroyed when the control room buildings collapsed. Residential buildings, store rooms etc, were also damaged or collapsed completely. Some equipment items (e.g. transformers) were dislocated from their foundations, but did not suffer structural damages; these have been placed back on original foundations, and are operational. For two transmission lines, a number of towers were damaged and had to be replaced or relocated.

9. Damage to the distribution infrastructure in both AJK and in the affected districts of NWFP (i.e. the service area of PESCO) was extensive, and includes 11kV and 0.44 kV distribution lines and feeders, transformers and other equipment, as well as consumer service connections. About 18,700 consumer connections in PESCO area, and about 61,000 in AJK, have been disrupted and need to be replaced. Some residential and office buildings of PESCO and AJKED have been damaged/destroyed, and need to be reconstructed. The damage to distribution networks is roughly equally divided between the utilities' assets (lines, transformers, civil works, etc) and consumer service connections (including new meters, service drops, service masts, etc).

10. **Damage by District.** The impact on distribution infrastructure appears to have been greater in AJK than in NWFP. By contrast, the estimate of damages to STG facilities appears to be larger in the NWFP districts.

11. The damage to distribution networks in AJK is about Rs. 173 million; damage to IESCO's STG networks, which are located in AJK is Rs. 66 million; and damage to hydro stations owned by the AJK Government is estimated at about Rs. 50 million.

12. Damage to distribution networks in NWFP is estimated at about Rs. 125 million, and damage to PESCO's STG network is about Rs. 173 million. The cost of replacement works at Allai Khawar

hydropower project – while this power plant is to be implemented by WAPDA, it is physically located in Kohistan District of NWFP – is about Rs. 26.3 million.

13. **Immediate actions taken by Government agencies/companies.** Electricity bulk supply, through the 132kv lines from PESCO and IESCO, was restored to near pre-earthquake levels within days of the October 8th earthquake. The distribution and retail service delivery areas were the most damaged, but partial restoration was achieved quickly by the responsible agencies. Based on feedback from the various sector cluster teams it appears that, due to the early actions of the responsible agencies, power supply appears to be adequate at the moment. The Government announced relief of electricity payments for the next three months.

14. The thrust of the early actions was to provide spares and manpower from unaffected areas, and bring these “reconstruction teams” with spare parts to the affected areas to restore the power installations. Most of the immediate repair works are of temporary nature but it is expected that these solutions will be in place during the short term horizon.

B.2 Reconstruction and Recovery Strategy

15. The service recovery and reconstruction needs in the power sector from now and for the next 3 years can be summarized as follows:

- Emergency procurement of high and low voltage lines, transformers, grid station equipment, tools, vehicles, materials for operational and staff quarter buildings, including replacement of material already provided from other companies and projects.
- Electrification, which covers both installation and supply, of the tent villages.
- Emergency repairs and reconstruction of the damaged electricity network and related buildings.

Table 3: Power Sector Reconstruction Costs

| | Unit | Quantity | Cost of Damage |
|---|------|----------|-----------------|
| Hydro Power Plant | nos. | 10 | 70.69 |
| 132kV Line | km | 2.00 | 34.00 |
| 132/33kV Substation ¹ | nos. | 5 | 88.72 |
| 33kV Line | km | 10.00 | 4.00 |
| 33/11kV Substation ² | nos. | 5 | 70.10 |
| 11kV lines | km | 100.00 | 35.08 |
| 11/0.4kV substation ³ | nos. | 566 | 75.29 |
| LT lines | km | 110.00 | 27.71 |
| Service connection | nos. | 79,723 | 124.44 |
| Buildings | - | | 165.71 |
| Spares | - | | 20 |
| Tools & Vehicles | - | | 4.00 |
| Tent Villages - Electricity supply for 1 year | | | 180.00 |
| Tent Villages - Electricity Installation | | | 90.00 |
| Electricity Relief to affected areas (3 months) | | | 657.00 |
| Electricity Installation to Anticipated new towns | - | - | 200.00 |
| Total Reconstruction Costs - Power Sector | | | 1,848.74 |

- Provision of cash for supply of electricity to the affected areas to compensate responsible agencies for the Government’s decision to grant 3 months of payment relief.
- Upgrading and expansion of power sector systems to improve access of the poor to electricity, and provide electricity to promote economic development in the earthquake affected area.

16. **Short Term Priority (up to 18 months).** There are two equally important immediate priorities, namely (i) electrification of the tent villages, and (ii) restoration of electricity supply to the customers that have yet to receive resumed services. Accordingly, short term requirements will be repair and rehabilitation of existing damaged distribution lines, transformers, and service connections. As houses are being erected in place of the damaged ones new service connections are needed and where new housing is being developed sufficient provision of electricity must be an integrated part of the planning and implementation process. The cost estimates reflect technological upgrading of the equipment to ensure improved efficiency and quality of service, which will benefit the area through increased economic activity. This means that transformers that were overloaded prior to the earthquake and damaged have been replaced with a suitable sized transformer for the estimated load it will serve during the next five years. In terms of cost allocation, the power sector could consume the above costs in the short term with construction activities possibly spilling over to the early periods of the medium to long term.

17. **Medium to Long Term Priorities (18 months to 3 years).** Several projects concerning power generation, transmission, and distribution were already in place prior to the earthquake to address increased electricity demand in the affected areas. It is important that these projects continue to be supported and sufficiently funded. As the reconstruction work progress across all sectors, continued monitoring and adjustment of the medium to long term demand forecast for the affected areas should be done, resulting in updated plans for generation capacity and required investments in the power sector.

18. The ability of consumers to pay for energy need to be further investigated. Already a 3 months moratorium has been declared by the Government concerning electricity payments, and as electricity is envisioned to be provided for free in the tent villages it should be expected that other affected people residing outside the tent villages would also make claims to similar relief provisions. As any such relief decisions would have to be considered across sector boarders we are not advocating any particular arrangements but rather bring the subject for consideration. It is critical that cash payments are made to energy providers (electricity and petroleum companies) to ensure sufficient cash flow within the sectors to pay the providers so that no sectoral effects negatively impact the financial and technical viability and further development of the energy sector.

C. Fuels Sector

19. The earthquake-affected Districts of AJK and NWFP are predominantly dependent⁴ on LPG and firewood for their cooking needs, while small amounts of kerosene is consumed for lighting if the village/town is not electrified. There are a number of LPG marketing and distribution companies, mostly private, operating in these Districts through a chain of dealers/points of sale that are supplied LPG from Rawalpindi area. Transport fuels (petrol and diesel) are also supplied to these districts by a number of Oil marketing Companies (OMC) through their retail outlets from their storage facilities in Sihala, Chaklala, Morgah, Taru Jabba, etc. All OMCs, except one, are privately-owned. In the earthquake-affected Districts, there were no major oil or LPG installations, but only the LPG distributor facility or oil retail outlets. The total number of retail outlets of different OMCs, and the annual sales, is provided in Table 1.

⁴ Only the town of Mansehra is connected with the natural gas pipeline system of SNGPL; after the earthquake, the distribution system was isolated and thoroughly checked for any damage. There was none. However, minor damage to the system in Islamabad was experienced.

Table 4: Petroleum Products Distribution Network

| | (No and '000 liters.) | | | | | | |
|--------------|-----------------------|-----------|--------|----------|-----|----------|-----------|
| | PSO | Shell | Caltex | Total | APL | Admore | Total |
| AJK | 7 | 15 | | 0 | | 1 | 23 |
| NWFP | 27 | 17 | | 1 | | | 45 |
| Total | 34 | 32 | | 1 | | 1 | 68 |
| Sales | 10,020 | 39,190 | | | | | 49,210 |

Source: Oil Companies Advisory Committee Annual Report, 2003 and OMC recent data.

C.1 Damage Overview and Recovery Needs

20. Assessment of the damage was done through the support of Ministry of Petroleum & Natural Resources (MPNR), and by circulating a questionnaire among the LPG marketing and distribution companies, and OMCs. Data received from most of these companies indicated that, notwithstanding the severe intensity of the earthquake, there has been no damage to the storage facilities in Rawalpindi and Peshawar, and minimal damage to the distribution network in the affected districts. According to preliminary estimates, the total cost of damage in the fuel sector is estimated at about Rs. 102 million.

21. **Categories of damage.** The damage to the fuel supply system in the earthquake-affected Districts of AJK and NWFP was mostly due to the destruction of distributor/dealer/agents premises or the oil retail outlets, with the consequent loss of partial or full inventory of filled/empty LPG bottles or petrol and/ or diesel through storage tanks. There has been some damage to gas meters, pipelines, and office buildings.

22. Table 5 provides estimates of earthquake damage by major categories, separately for AJK and NWFP, and by public- and private-sector entities:

Table 5: Summary of Earthquake Damage to Fuel Supply Infrastructure
(Rs. Million)

| Description | Unit | NWFP-Affected Districts* | | | | AJK-Affected Districts | | | | Grand Total Cost |
|-------------------------------|------|--------------------------|---------|-------|-------------|--|---------|-------|-------------|------------------|
| | | Physical Quantity | | | Cost | Physical Quantity | | | Cost | |
| | | Public | Private | Total | | Public | Private | Total | | |
| Petroleum Sub-sector | | | | | | | | | | |
| Storage Tanks | MT | 0 | 19 | 19 | 0.3 | 0 | 0 | 0 | 0.0 | 0.3 |
| Retail Outlets (w/o land) | No. | 1 | 3 | 4 | 30.0 | 1 | 5 | 6 | 45.0 | 75.0 |
| Dispensing Unit | No. | 3 | 9 | 12 | 0.4 | 3 | 15 | 18 | 0.5 | 0.9 |
| Inventory | MT | 0 | 0 | 0 | 0.0 | 0 | 10 | 10 | 0.5 | 0.5 |
| Sub-Total | | | | | 30.7 | | | | 46.0 | 76.7 |
| Natural Gas Sub-sector | | | | | | | | | | |
| Sub-Total | No. | | | | 3.0 | Natural gas not supplied in AJK | | | | 3.0 |
| LPG Sub-sector | | | | | | | | | | |
| Distributor (Asset+Inv) | No. | 0 | 24 | 24 | 7.2 | 0 | 22 | 26 | 6.6 | 13.8 |
| Cylinder: Point of Sale | No. | 0 | 2400 | 2400 | 3.1 | 0 | 2200 | 26 | 2.9 | 6.0 |
| LPG Inventory: POS | Kg | 0 | 38 | 38 | 1.5 | 0 | 29 | 26 | 1.2 | 2.7 |
| Sub-Total | | | | | 11.8 | | | | 10.6 | 22.4 |
| Grand Total | | | | | 45.5 | | | | 56.6 | 102.1 |

* Includes small damage to infrastructure in Islamabad as well.

Source: Oil and LPG Companies.

23. **Damage by District.** While estimates of damage are still awaited from a number of distributors/retail outlets in affected Districts, a conservative estimate has been made on the basis of typical assets and the level of inventories usually maintained. Estimates of actual losses may be revised based on input from all distributors (especially LPG), who are currently not contactable. Table 6 provides details of the damage to the fuel sector assets and inventories.

24. **Immediate Actions Taken by Government Agencies/Companies.** Soon after the earthquake, MPNR asked all public sector and private companies to assess the damage to lives and properties, and ensure the least possible disruption of essential fuel supplies. Since supplies were dispatched from storage facilities in Rawalpindi and Peshawar areas by road, and the road network was blocked, there was some initial disruption. Because of the damage to the LPG distribution network and destruction of households, supplies have been affected.

Table 6: Retail Outlets by District – Damages and Loss of Inventory

| Unit | Muzaffarabad | Rawalakot (Poonch) | Bagh | Abbottabad | Mansehra | Kohistan | Batagram | Shangla | Other | Total* | |
|-----------------------------|--------------|--------------------|-------------|-------------|-------------|--------------|-------------|-------------|-------------|--------------|--------------|
| Petroleum Sub-sector | | | | | | | | | | | |
| Total Retail Outlets | No. | 12 | 9 | 8 | 13 | 10 | 4 | 3 | 3 | 6 | 68 |
| Damaged Retail Outlets | No. | 4 | 1 | 1 | 0 | 3 | 0 | 0 | 0 | 1 | 10 |
| Loss of Inventory | 000 L | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Damage to Facilities | M Rs | 30.70 | 7.59 | 7.59 | 0.00 | 22.77 | 0.00 | 0.00 | 0.00 | 7.59 | 76.24 |
| Value of Inventory | M Rs | 0.45 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.45 |
| Sub-total | M Rs | 31.15 | 7.59 | 7.59 | 0.00 | 22.77 | 0.00 | 0.00 | 0.00 | 7.59 | 76.69 |
| LPG Sub-sector | | | | | | | | | | | |
| Distrib/ Agents affected | No. | 15 | 4 | 3 | 5 | 8 | 2 | 2 | 0 | 7 | 46 |
| Loss of Inventory | MT | 22.37 | 2.95 | 3.53 | 2.94 | 9.43 | 1.18 | 0.59 | 0 | 23.53 | 66.52 |
| Damage to Facilities | M Rs | 6.45 | 1.72 | 1.29 | 2.15 | 3.44 | 0.86 | 0.86 | 0 | 3.01 | 19.78 |
| Value of Inventory | M Rs | 0.89 | 0.12 | 0.14 | 0.12 | 0.38 | 0.05 | 0.02 | 0.00 | 0.94 | 2.66 |
| Sub-total | M Rs | 7.34 | 1.84 | 1.43 | 2.27 | 3.82 | 0.91 | 0.88 | 0.00 | 3.95 | 22.44 |
| Grand Total | M Rs | 38.50 | 9.43 | 9.02 | 2.27 | 26.59 | 0.91 | 0.88 | 0.00 | 11.54 | 99.13 |

Note: Muzaffarabad, Rawalakot and Bagh are in AJK; Abbottabad, Mansehra, Kohistan, Batagram, Shangla and Others are in NWFP.

Source: OMC / LPG company estimates.

25. The Government and OMCs have taken adequate measures to ensure that there is no immediate shortage of fuel for the transport fleet engaged in relief work. Natural gas networks in Abbottabad and Mansehra areas were thoroughly checked after the earthquake, and supplies restored to normal levels soon thereafter. LPG supplies have been affected, however as consumption of LPG is directly dependent on the rehabilitation of the population in their permanent abode. Currently, the population in tent villages is using firewood for cooking, but there is concern regarding the affordability and sustainability of supplies during the coming winter months.

C.2 Reconstruction and Recovery Strategy

26. Based on the assessment of damage, the following three strategic measures need immediate consideration: (a) repair and rehabilitation of LPG and liquid fuels distribution infrastructure damaged by the earthquake; (b) development and finalization of a program of fuel supplies during the winter months, including *inter alia* LPG supplies to the tent villages, diesel for stand-alone generators, firewood supplies for remote locations, etc; and (c) creation of some LPG bottling and petroleum products storage infrastructure in the affected Districts. In terms of reconstruction approach, it is expected that the private sector companies, both petroleum and LPG, will ensure that sufficient capacities will be established in accordance with growth in demand. The Government would need to consider payments (full or partial), where applicable, for fuels delivered to ensure continued supply.

27. **Short Term Priority (up to 18 months).** The short term needs could be considered as comprising of the first two measures of the strategic plan described in para. 23. Table 7 provides details of major cost elements.

Table 7: Short-term needs of the Fuel Sector (0 -18 months)

| Reconstruction & Recovery Action | Physical Quantity | Estimated Cost (Rs. Mill.) |
|--|---|----------------------------|
| Repair to petroleum retail outlets | 4 in NWFP; 6 in AJK | 76.20 |
| Rehabilitation of LPG distributors | 24 in NWFP; 26 in AJK | 19.80 |
| Cost of free supply of LPG to tent villages | 10 villages -20 cylinders/day for 180 days | 17.92 |
| Cost of free diesel for 30 generators in tent villages | 25 KW generators, operating for eight hours/day for 180 days @ 0.5 Kg/Kwh | 25.00 |
| Cost of immediate tanks, etc | 4 tanks of 10 MT each | 0.72 |
| Total | | 138.64 |

Source: Mission estimates

28. **Medium to Long Term Priorities (18 months to 3 years).** In the medium to long term, AJK and NWFP Districts need to develop strategic stocks of petroleum products and LPG so that it could meet its needs for at least one month in case of natural calamities. This would be in the form of a fleet of bowzers to transport bulk-product (LPG and petroleum products) to one central depot in AJK and Mansehra, one LPG bottling facility in Rawalakot and Shangla, and a number of new retail outlets in locations currently not served with commercial fuels. A preliminary cost estimate of these needs is provided in Table 5,

Table 8: Medium and Long term needs of the Fuel Sector (18 months -3 years)

| Reconstruction & Recovery Action | Physical Quantity | Estimated Cost (Rs. Mill.) |
|--|---|----------------------------|
| Petroleum and LPG strategic storage | For one month cover | 50.00 |
| Bowzers for transport of wholesale product | 10 bowzers @ Rs 5 million each | 50.00 |
| LPG bottling facility | 2x20 TPD facility (Rs. 70 million each) | 140.00 |
| New retail outlets | 30 new outlets (Rs. 5 million each) | 150.00 |
| Total | | 390.00 |

Source: Mission estimates.

D. Environmental and Social Aspects

29. Primarily it is the power distribution networks in the affected areas within AJK and NWFP that need to be rehabilitated, and no significant adverse environmental and social impacts are anticipated in the energy sector. In terms of any further expansive reconstruction efforts in the medium and long terms appropriate national and provincial environmental and social impacts legislation and guidelines will have to be adopted.

30. In terms of the petroleum sector the initial inspection of fuel storage facilities revealed limited damage, and accordingly relatively limited adverse environmental impacts. However, it is suggested that a more detailed examination of fuel storage facilities take place in the near future in order to establish the actual adverse environmental impacts, but more importantly to ensure that there is no future leakage/loss of petroleum products.