

CHAPTER 7
SUMMARY OF TRANSFERRED
TECHNOLOGIES

CHAPTER 7 SUMMARY OF TRANSFERRED TECHNOLOGIES

7.1 Technology Transfer of Technology

The technologies of PV and Wind generation have been transferred through technology transfer seminar and site survey. The main items of transferred technologies are as follows.

(1) PV System

- Pilot plants installation
- Operation and Maintenance of the pilot plants
- Analysis of solar irradiation and power output data at pilot plants
- Comparison of solar irradiation data between meteorological agency and pilot plants
- Selection criteria for Sums suitable for PV system installation
- Selection criteria for sites suitable for PV system installation
- Current topics of PV systems

(2) Wind system

- Pilot plants installation
- Operation and Maintenance of the pilot plants
- Analysis of wind and power output data at pilot plants
- Comparison of wind speed data between meteorological agency and pilot plants
- Selection criteria for Sums suitable for Wind system installation
- Selection criteria for sites suitable for Wind system installation
- Current topics of Wind systems

7.2 Transfer Plan for Operation and Maintenance

Regarding Operation and Maintenance Organization:

- Desirable organization for operation and maintenance of the power plant (personnel, supervision and monitoring system, training)
- Establishment of the management principles (self-reliance, self-responsibility)
- Keeping accounting records, operation records and maintenance records
- Financial management (maintenance fund, the yearly diminishing value of the machine)

Regarding Maintenance System:

- Technical maintenance
- Saving the fund for the maintenance cost
- Maintenance system (personal, organization, linkage with the Central and Aimag Government)

7.3 Acknowledgements

Finally, the Study team again acknowledges the helpful cooperation and assistance of the Department of Integrated Policy and Strategic planning of the Ministry of Infrastructure Development, Renewable Energy Corporation and staff during our field work and during the preparation of the reports.

APPENDIX

Appendix-1 Minutes of Meeting

MINUTES OF MEETING FOR THE MASTER PLAN STUDY
FOR RURAL POWER SUPPLY
BY RENEWABLE ENERGY
IN MONGOLIA

The Master Plan Study Team (the Team) of the Japan International Cooperation Agency (JICA), which is headed by Mr. Yoshitomo WATANABE, visited Mongolia from October 3, 1998 and had meeting with the officials concerned of the Energy Department, Ministry of Infrastructure Development (MOID) for the captioned study on October 5 and 6, 1998.

In the meeting, the Team and MOID confirmed the following matters.

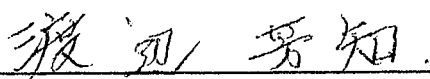
1. **Objective Sum Centers** : The objective sum centers for the Master Plan Study for Rural Power Supply (the Study) to be 171 sum centers stated in the attached list.
2. **Pilot Plants Installation** : The pilot plants consist of solar and wind power generators are to be installed in the following sum centers.
 - Tariat (Arkhangai aimag)
 - Bayan-undur (Uvurhangai aimag)
 - Adaatsag (Dundgovi aimag)

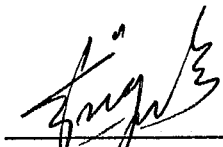
Only in the case that the above sum centers have concrete plan to tap distribution line to the grid and receive power from that in three years, the candidate sum center for the pilot plants will be re-considered.

3. **Operation and Management of Pilot Plants** : MOID take full responsibility for supporting the sum centers about operation and maintenance of pilot plants. Considering the future operation and maintenance after the Study, the Team recommended that an appropriate organization concerned, if necessary, be participated in operation and maintenance work during and after the study period.

October 6, 1998

Ulaanbaatar, Mongolia


Mr. Yoshitomo Watanabe
Team Leader
Nippon Koei Co., Ltd.


Mr. Gendensuren Yondongombo
Director General
Energy Department
Ministry of Infrastructure Development

List of Sum for Master Plan Study

| Number | Name | Number | Name | Number | Name |
|--------|---------------|--------|-------------------|--------|-------------------|
| I | UMNUGOVI | V | SUKHBAATAR | XI | ARKHANGAI |
| 1 | Bayandalai | 58 | Ongon | 115 | Khantai |
| 2 | Bayan-Ovoo | 59 | Dariganga | 116 | Tariat |
| 3 | Bulgan | 60 | Naran | *117 | Tsakhir (Chuluut) |
| 4 | Gurvantes | 61 | Bayandelger | XII | ZAVKHAN |
| 5 | Mandal-Ovoo | 62 | Erdenetsagaan | 118 | Shiluustei |
| 6 | Maniai | 63 | Sukhbaatar | 119 | Durvuljin |
| 7 | Noyon | 64 | Tumentsoigt | 120 | Yaruu |
| 8 | Nomgon | 65 | Tuvshinshree | 121 | Erdenekhairkhan |
| 9 | Sevrei | 66 | Uulbayan | 122 | Zavkhanmandal |
| 10 | Khanbogd | 67 | Munkhkhagan | 123 | Urgamal |
| 11 | Tsogt-Ovoo | 68 | Burentsoigt | 124 | Santmargats |
| 12 | Khurmen | VI | DORNOD | 125 | Tsetsen-Uul |
| 13 | Tsogtsetsii | 69 | Matad | 126 | Ider |
| II | GOVI-ALTAI | 70 | Sumber | 127 | Ikh-Uul |
| 14 | Erdene | 71 | Khalkh gol | 128 | Tes |
| 15 | Tsogt | 72 | Khulunbuir | 129 | Tsagaanchuluut |
| 16 | Chandmani | 73 | Tsagaan-Ovoo | 130 | Tsagaankhairkhan |
| 17 | Altai | 74 | Chuluunkhoroot | 131 | Telmen |
| 18 | Delger | 75 | Bayan-Uul | 132 | Tudevtei |
| 19 | Taishir | 76 | Bayandun | 133 | Songino |
| 20 | Bugat | VII | KHENTII | 134 | Otgon |
| 21 | Tseel | 77 | Gurvanbayan | 135 | Numrug |
| 22 | Tugrug | 78 | Bayan-Adraga | 136 | Asgat |
| 23 | Sharga | 79 | Binder | 137 | Bayankhairkhan |
| 24 | Tonkhil | 80 | Batshireet | 138 | Bulnai |
| 25 | Darvi | 81 | Norovlin | XIII | BULGAN |
| 26 | Khaliun | 82 | Burenkhaan | 139 | Teshig |
| 27 | Biger | 83 | Dadal | XIV | UVS |
| 28 | Khukhmorit | VIII | DUNDGOVI | 140 | Undurkhangai |
| 29 | Bayan-Uul | 84 | Ulziit | 141 | Tsagaankhairkhan |
| 30 | Jargalan | 85 | Undurshil | 142 | Zuunkhangai |
| 31 | Guulin | 86 | Bayanjargalan | 143 | Khyargas |
| III | BAYANKHONGOR | 87 | Adaatsag | 144 | Baruuntruun |
| 32 | Shinejinst | 88 | Erdenedalai | 145 | Melchin |
| 33 | Bayan-Uundur | IX | UVURKHANGAI | 146 | Zuungovi |
| 34 | Bayanlig | 89 | Bogd | 147 | Bukhmurun |
| 35 | Bayangovi | 90 | Baruunbayan-Ulaan | 148 | Zavkhan |
| 36 | Bogd | 91 | Guchin-Uus | 149 | Tes |
| 37 | Jinst | 92 | Bayan-Uundur | XV | KHOVD |
| 38 | Baatsagaan | 93 | Khairhandulaan | 150 | Myangad |
| 39 | Bayantsagaan | 94 | Nariinteel | 151 | Zereg |
| 40 | Khureemeral | 95 | Bayanteeg | 152 | Darvi |
| 41 | Gurvanbulag | X | KHUVSGUL | 153 | Altai |
| 42 | Jargalant | 96 | Jargalant | 154 | Uyench |
| 43 | Galuut | 97 | Galt | 155 | Bulgan |
| 44 | Erdenetsogt | 98 | Shine-Ider | 156 | Tsetseg |
| 45 | Bayan-Ovoo | 99 | Tumurbulag | 157 | Must |
| 46 | Bayanbulag | 100 | Burentogtokh | 158 | Munkhkhairkhan |
| 47 | Buutsagaan | 101 | Tsetserleg | 159 | Mankhan |
| 48 | Bumbugur | 102 | Arbulag | 160 | Chandmani |
| 49 | Ulziit | 103 | Bayanzurkh | 161 | Khovd |
| 50 | Zag | 104 | Chandmani-Uundur | 162 | Buyant |
| IV | DORNOGOVI | 105 | Tsagaan-Uur | 163 | Durgun |
| 51 | Erdene | 106 | Tsagaan-Uul | XVI | BAYAN-ULGI |
| 52 | Delgerekh | 107 | Ulaan-Uul | 164 | Tolbo |
| 53 | Zamin-Uud | 108 | Renchinlkhunbe | 165 | Tsagaannuur |
| 54 | Mandakh | 109 | Tunel | 166 | Bulgan |
| 55 | Saikhandulaan | 110 | Tosontsengel | 167 | Dehuun |
| 56 | Khatanbulag | 111 | Alag-Erdene | 168 | Altai |
| 57 | Khuvsgul | 112 | Khatgal | 169 | Buyant |
| - | - | 113 | Tsagaannuur | 170 | Bayannuur |
| - | - | 114 | Erdenebulgan | 171 | Altantsugts |

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MINUTES OF MEETING
FOR
THE MASTER PLAN STUDY FOR RURAL POWER SUPPLY BY RENEWABLE ENERGY
IN
MONGOLIA

The Master Plan Study Team (the Team) of the Japan International Cooperation Agency (JICA), which is headed by Mr. Yoshitomo WATANABE, visited Mongolia on October 3, 1998. The team executed the study in the sites and had meetings with the officials concerned of the Energy Department, Ministry of Infrastructure Development (MOID) through the study period.

As the results of the study, the Team and MOID confirmed the following matters.

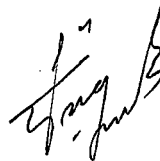
1. **Objective Sum Centers :** The objective sum centers for the Master Plan Study for Rural Power Supply (the Study) have been modified from the original ones to the new ones as indicated in the Attachment. The number of objective sum centers is 173.
2. **Consideration of Hydro Power Potential :** According to the data collected, it is difficult to much expect a viable generation plan by solar and wind energy in northwest region. Hydro power is further promising in this region compared with solar and wind. MOID requested the Team to give a priority to consideration of hydro potential especially in the region.
3. **Potential of Geothermal:** Based on the past study, geothermal potential is not sufficient for power generation. MOID requested the Team to explore the way to harness geothermal potential in the field of heating.

December 14, 1998

Ulaanbaatar, Mongolia



Mr. Yoshitomo Watanabe
Team Leader
Nippon Koei Co., Ltd.



Mr. Gendensuren Yondongombo
Director General
Energy Department
Ministry of Infrastructure Development

List of Sum for Master Plan Study

| Serial No. | Original No. | Name | Serial No. | Original No. | Name |
|------------|--------------|--------------|------------|--------------|----------------|
| | I | UMNUGOVI | 45 | 48 | Bumbugur |
| 1 | 1 | Bayandalai | | 49 | Ulziit |
| 2 | 2 | Bayan-Ovoo | | 50 | Zag |
| 3 | 3 | Bulgan | IV | IV | DORNOGOVI |
| 4 | 4 | Gurvantes | 46 | 51 | Erdene |
| 5 | 5 | Mandal-Ovoo | 47 | 52 | Delgerekh |
| 6 | 6 | Manlai | 48 | 53 | Zamiin-Uud |
| 7 | 7 | Noyon | 49 | 54 | Mandakh |
| 8 | 8 | Nomgon | 50 | 55 | Saikhandulaan |
| 9 | 9 | Sevrei | 51 | 56 | Khatanbulag |
| 10 | 10 | Khanbogd | 52 | 57 | Khuvsgul |
| 11 | 11 | Tsogt-Ovoo | 53 | New-1 | Ulaanbadrakh |
| 12 | 12 | Khurmen | V | V | SUKHBAATAR |
| 13 | 13 | Tsogttsetsii | 54 | 58 | Ongon |
| II | II | GOVI-ALTAI | 55 | 59 | Dariganga |
| 14 | 14 | Erdene | 56 | 60 | Naran |
| 15 | 15 | Tsogt | 57 | 61 | Bayandelger |
| 16 | 16 | Chandmani | 58 | 62 | Erdenetsagaan |
| 17 | 17 | Altai | 59 | 63 | Sukhbaatar |
| | 18 | Delger | 60 | 64 | Tumentsogt |
| 18 | 19 | Taishir | 61 | 65 | Tuvshinshiree |
| 19 | 20 | Bugat | 62 | 66 | Uulbayan |
| 20 | 21 | Tseel | 63 | 67 | Munkhkhaan |
| 21 | 22 | Tugrug | 64 | 68 | Burentsogt |
| 22 | 23 | Sharga | VI | VI | DORNOD |
| 23 | 24 | Tonkhil | 65 | 69 | Matad |
| 24 | 25 | Darvi | | 70 | Sumber |
| 25 | 26 | Khaliun | 66 | 71 | Khalkh gol |
| 26 | 27 | Biger | 67 | 72 | Khulunbuir |
| 27 | 28 | Khukhmorit | 68 | 73 | Tsagaan-Ovoo |
| 28 | 29 | Bayan-Uul | 69 | 74 | Chuluunkhoroot |
| 29 | 30 | Jargalan | 70 | 75 | Bayan-Uul |
| | 31 | Gulin | 71 | 76 | Bayandun |
| III | III | BAYANKHONGOR | VII | VII | KHENTII |
| 30 | 32 | Shinejinst | | 77 | Gurvanbayan |
| 31 | 33 | Bayan-Uundur | 72 | 78 | Bayan-Adraga |
| 32 | 34 | Bayanlig | 73 | 79 | Binder |
| 33 | 35 | Bayangovi | 74 | 80 | Batshireet |
| 34 | 36 | Bogd | 75 | 81 | Norovlin |
| 35 | 37 | Jinst | | 82 | Burenkhaan |
| 36 | 38 | Baatsagaan | 76 | 83 | Dadal |
| 37 | 39 | Bayantsagaan | 77 | New-2 | Galshar |
| 38 | 40 | Khureemara | 78 | New-3 | Bayan-Ovoo |
| 39 | 41 | Gurvanbulag | VIII | VIII | DUNDGOVI |
| 40 | 42 | Jargalant | 79 | 84 | Ulziit |
| 41 | 43 | Galut | 80 | 85 | Undurshil |
| 42 | 44 | Erdenetsogt | 81 | 86 | Bayanjargalan |
| | 45 | Bayan-Ovoo | 82 | 87 | Adaatsag |
| 43 | 46 | Bayanbulag | 83 | 88 | Erdenedalai |
| 44 | 47 | Buutsagaan | 84 | New-4 | Saikhan-Ovoo |

Notes

- 1) Shaded sum is canceled sum.
- 2) "New-" means newly added sum.

List of Sum for Master Plan Study

| Serial No. | Original No. | Name | Serial No. | Original No. | Name |
|------------|--------------|-------------------|------------|--------------|------------------|
| 85 | New-5 | Khuld | 131 | 131 | Telmen |
| 86 | New-6 | Delgerkhangai | 132 | 132 | Tudevtei |
| IX | IX | UVURKHANGAI | 133 | 133 | Songino |
| 87 | 89 | Bogd | 134 | 134 | Otgon |
| 88 | 90 | Baruunbayan-Ulaan | 135 | 135 | Numrug |
| 89 | 91 | Guchin-Uс | 136 | 136 | Asgat |
| 90 | 92 | Bayan-Undur | 137 | 137 | Bayankhairkhan |
| 91 | 93 | Khairhandulaan | 138 | 138 | Bulnai |
| 92 | 94 | Nariinteel | 139 | New-9 | Bayantes |
| 93 | 95 | Bayanteeg | 140 | New-10 | Aldarkhaan |
| X | X | KHUVSGUL | XIII | XIII | BULGAN |
| 94 | 96 | Jargalant | 141 | 139 | Teshig |
| 95 | 97 | Galt | XIV | XIV | UVS |
| 96 | 98 | Shine-Ider | 142 | 140 | Undurkhangai |
| 97 | 99 | Tumurbulag | 143 | 141 | Tsagaankhairkhan |
| 98 | 100 | Burentogtokh | 144 | 142 | Zuunkhangai |
| 99 | 101 | Tsetserleg | 145 | 143 | Khyargas |
| 100 | 102 | Arbulag | 146 | 144 | Baruuntruun |
| 101 | 103 | Bayanzurkh | 147 | 145 | Malchin |
| 102 | 104 | Chandmani-Undur | 148 | 146 | Zuungovi |
| 103 | 105 | Tsagaan-Uur | 149 | 147 | Bukhmurun |
| 104 | 106 | Tsagaan-Uul | 150 | 148 | Zavkhan |
| 105 | 107 | Ulaan-Uul | 151 | 149 | Tes |
| 106 | 108 | Renchinkhunbe | XV | XV | KHOVD |
| 107 | 109 | Tunel | | 150 | Myangad |
| 108 | 110 | Tosontsengel | 152 | 151 | Zereg |
| 109 | 111 | Alag-Erdene | 153 | 152 | Darvi |
| 110 | 112 | Khatgal | 154 | 153 | Altai |
| 111 | 113 | Tsagaannuur | 155 | 154 | Uyench |
| 112 | 114 | Erdenebulgan | 156 | 155 | Bulgan |
| 113 | New-7 | Khankh | 157 | 156 | Tsetseg |
| XI | XI | ARKHANGAI | 158 | 157 | Must |
| 114 | 115 | Khangai | 159 | 158 | Munkhkhairkhan |
| 115 | 116 | Tariat | 160 | 159 | Mankhan |
| 116 | 117 | Tsakhir | 161 | 160 | Chandmani |
| 117 | New-8 | Chuluut | | 161 | Khovd |
| XII | XII | ZAVKHAN | | 162 | Buyant |
| 118 | 118 | Shiluustei | 162 | 163 | Durgun |
| 119 | 119 | Durvuljin | 163 | New-11 | Duut |
| 120 | 120 | Yaruu | 164 | New-12 | Erdeneburen |
| 121 | 121 | Erdenekhairkhan | XVI | XVI | BAYAN-ULGII |
| 122 | 122 | Zavkhanmandal | 165 | 164 | Tolbo |
| 123 | 123 | Urgamal | 166 | 165 | Tsagaannuur |
| 124 | 124 | Santmargats | 167 | 166 | Bulgan |
| 125 | 125 | Tsetsen-Uul | 168 | 167 | Deluun |
| 126 | 126 | Ider | 169 | 168 | Altai |
| 127 | 127 | Ikh-Uul | 170 | 169 | Buyant |
| 128 | 128 | Tes | 171 | 170 | Bayannuur |
| 129 | 129 | Tsagaanchuluut | 172 | 171 | Altantsugts |
| 130 | 130 | Tsagaankhairkhan | 173 | New-13 | Nogoonuur |

Notes

- 1) Shaded sum is canceled sum.
- 2) "New-" means newly added sum.

MINUTES OF MEETING
FOR
THE MASTER PLAN STUDY FOR RURAL POWER SUPPLY BY RENEWABLE ENERGY
IN
MONGOLIA

The Master Plan Study Team (the Team) of the Japan International Cooperation Agency (JICA), which is headed by Mr. Yoshitomo WATANABE, arrived in Mongolia on February 26, 1999, and will leave on March 12, 1999. During their stay in Mongolia, the Team submitted Progress Report No.1 to the Ministry of Infrastructure Development (MOID) and explained the contents of the report. The Team also executed the seminar No.1 for technology transfer and had meeting about the Master Plan Study in the next stage.

This minutes records the result of the meeting.

1. **Acceptance of Progress Report No. 1** : The Team submitted Progress Report No.1 to MOID and MOID accepted the report.
2. **Surveyed Sum Centers of Inventory Study** : The Team and MOID confirmed the modification of surveyed sum centers as given below;
 - ID No. 45 Bayan-Ovoo sum of Bayankhongor aimag is deleted.
This sum was deleted in the minutes of meeting dated December 14, 1999. However, the sum submitted the questionnaires of inventory study, then the sum was examined in the Progress Report No.1.
 - ID No. 50 Zag sum of Bayankhongor aimag is included.
This sum was deleted in the minutes of meeting dated December 14, 1999. The data is available because the sum submitted the questionnaires of inventory study.
 - ID 68 Burentsogt sum of Sukhbaatar aimag is deleted.
The sum was merged into Munkhkhaan sum (ID 67) and data is combined with that of Munkhkhaan sum.

One sum is newly included and one sum is deleted from the originally counted sums, thus the total number of surveyed sum is same as the previous one, 173.

3. **Candidate Sum Centers of Sample Survey** : The Team and MOID agreed to the candidate sum centers as shown in the attachment. The Team will prepare the schedule of the sample survey and show it to MOID later.



4. **Operation and Maintenance Cost of Plot Plant** : The Plot Plant sums, Tariat, Bayan-Undur and Adaatsag will save the operation and maintenance cost of Pilot Plant based on the actual consumed energy measured by energy meter at the following rate.

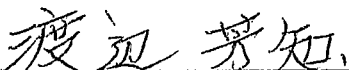
Tg100/kWh in winter (October 1 to March 31)

Tg50/kWh in summer (April 1 to September 30)

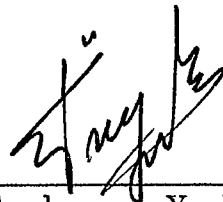
5. **Management of Operation and Maintenance Cost for Pilot Plant** : The Plot Plant sum centers will be responsible for the way and execution to collect and save the operation and maintenance cost for the Pilot Plant. The expenditure for the operation and maintenance will also be managed by the Pilot Plant sums and will be monitored by the Team during the Master Plan Study period.
6. **Preparation of Pilot Plant Installation Work** : The Pilot Plant sums shall be responsible for the preparation of Pilot Plant installation such as mentioned below;
- To keep the transported Pilot Plant equipment from any damage and pilferage loss before installation.
 - To shift the existing fences in Bayan-Undur and Adaatsag.
 - To remove firewood in Tariat.
 - To prepare accommodation for seven Japanese and four local persons.
 - To make arrangement to cooperate on the installation work like wiring in the hospital.
7. **Establishment of Operation and Maintenance Group for Pilot Plant** : The Pilot Plant sums will establish an operation and maintenance group for Pilot Plants consisting of manager, operator and accountant.

March 10, 1999

Ulaanbaatar, Mongolia



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Mr. Gendensuren Yondongombo
Director General
Integrated Policy and Strategic Planning
Department
Ministry of Infrastructure Development

Candidate Sum Centers of Sample Survey

| No. | ID | Sum Name | Aimag Name |
|-----|------|---------------|--------------|
| 1 | 164 | Tolbo | BAYAN-ULGII |
| 2 | 36 | Bogd | BAYANKHONGOR |
| 3 | 124 | Santmargats | ZAVKHAN |
| 4 | 91 | Guchin-Us | UVURKHANGAI |
| 5 | 9072 | Bayan-Ovoo | KHENTII |
| 6 | 65 | Tuvshinshiree | SUKHBAATAR |
| 7 | 88 | Erdenedalai | DUNDGOVI |
| 8 | 54 | Mandakh | DORNOGOVI |
| 9 | 153 | Altai | KHOVD |
| 10 | 115 | Khangai | ARKHANGAI |
| 11 | 26 | Khaliun | GOVI-ALTAI |
| 12 | 5 | Mandal-Ovoo | UMNUGOVI |
| 13 | 112 | Khatgal | KHUVSGUL |
| 14 | 69 | Matad | DORNOD |
| 15 | 8 | Nomgon | UMNUGOVI |



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FOR
THE MASTER PLAN STUDY FOR RURAL POWER SUPPLY BY RENEWABLE ENERGY
IN
MONGOLIA

The Master Plan Study Team (the Team) of the Japan International Cooperation Agency (JICA), which is headed by Mr. Yoshitomo WATANABE, arrived in Mongolia on May 12, 1999, and will leave on July 10, 1999. During their stay in Mongolia, the Team carried out the sample survey, installation of the Pilot Plants and had meeting with the officials concerned of the Ministry of Infrastructure Development (MOID).

Regarding the study, the Team and MOID confirmed the following matters.

1. **Target Sum Centers of the Master Plan** : ID No. 138 Bulnai sum of Zavkhan aimag was merged into Tosontsengel sum. The inventory study data of Bulnai sum originally includes the data of Tosontsengel sum. Thus the Name of Bulnai is simply replaced by Tosontsengel.

The latest list of the target sum centers is attached as Attachment-1. Further revision will be made and the final target sum centers for the Master Plan will be decided in the next site study in September 1999.

2. **Other Donors' Activities** : MOID shall coordinate the other donors' activities concerning renewable energy application in the target sum centers with this Master Plan Study.
3. **Operation and Maintenance for Pilot Plant** : MOID takes full responsibility for supporting the three sum centers: Tariat, Bayan-Undur and Adaatsag, for operation and maintenance of the Pilot Plants.
4. **Key and Manual of Pilot Plants** : The keys and operation manuals in Mongolian language of the Pilot Plants are distributed as follows.

Key (One set consists of two pieces)

| | |
|-----------------------------|------------------------|
| Three sum centers | 6 sets (two sets each) |
| Energy Consulting Co., Ltd. | 2 sets |
| MOID | 2 sets |
| Nippon Koei Co., Ltd. | 4 sets |




Operation Manual

| | |
|------------------------------|-----------------------|
| Three sum centers | 3 sets (one set each) |
| Energy Consulting Co., Ltd. | 2 sets |
| MOID | 2 sets |
| Renewable Energy Corporation | 1 set |
| Nippon Koei Co., Ltd. | 1 set |


5. **Tools and Spare Parts of Pilot Plants** : The maintenance tools, measuring instrument and spare parts of the Pilot Plants are kept as shown in the Attachment-2.
6. **Damaged Battery of Pilot Plant in Bayan-Undur Sum** : One battery was found damaged during the installation period. That seems to be damaged in transportation. Due to this damaged one, other one battery cannot be used in order to level the voltages of system A and B, which are operated in parallel. JICA will apply the transportation insurance to replace these batteries.

July 9, 1999

Ulaanbaatar, Mongolia



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Team Leader
Nippon Koei Co., Ltd.



Mr. R. Bud
Director General
Integrated Policy and Strategic Planning
Department
Ministry of Infrastructure Development

List of Sum for Master Plan Study

| Serial No. | Original No. (ID No.) | Name | Serial No. | Original No. (ID No.) | Name |
|------------|--------------------------|--------------|------------|--------------------------|----------------|
| I | I | UMNUGOVI | 45 | 48 | Bumbugur |
| 1 | 1 | Bayandalai | | 49 | Ulziit |
| 2 | 2 | Bayan-Ovoo | 46 | 50 | Zag |
| 3 | 3 | Bulgan | IV | IV | DORNOGOVI |
| 4 | 4 | Gurvantes | 47 | 51 | Erdene |
| 5 | 5 | Mandal-Ovoo | 48 | 52 | Delgerekh |
| 6 | 6 | Manlai | 49 | 53 | Zamiin-Uud |
| 7 | 7 | Noyon | 50 | 54 | Mandakh |
| 8 | 8 | Nomgon | 51 | 55 | Saikhandulaan |
| 9 | 9 | Sevrei | 52 | 56 | Khatabbulag |
| 10 | 10 | Khanbogd | 53 | 57 | Khuvsgul |
| 11 | 11 | Tsogt-Ovoo | 54 | 9041 | Ulaanbadrakh |
| 12 | 12 | Khurmen | V | V | SUKHBAATAR |
| 13 | 13 | Tsogttsetsii | 55 | 58 | Ongon |
| II | II | GOVI-ALTAI | 56 | 59 | Dariganga |
| 14 | 14 | Erdene | 57 | 60 | Naran |
| 15 | 15 | Tsogt | 58 | 61 | Bayandelger |
| 16 | 16 | Chandmani | 59 | 62 | Erdenetsagaan |
| 17 | 17 | Altai | 60 | 63 | Sukhbaatar |
| | 18 | Delger | 61 | 64 | Tumentsogt |
| 18 | 19 | Taishir | 62 | 65 | Tuvshinshiree |
| 19 | 20 | Bugat | 63 | 66 | Uulbayan |
| 20 | 21 | Tseel | 64 | 67 | Munkhkhaan |
| 21 | 22 | Tugrug | | 68 | Burentsogt |
| 22 | 23 | Sharga | VI | VI | DORNOD |
| 23 | 24 | Tonkhil | 65 | 69 | Matad |
| 24 | 25 | Darvi | | 70 | Sumber |
| 25 | 26 | Khaliun | 66 | 71 | Khalkh gol |
| 26 | 27 | Biger | 67 | 72 | Khulumbuir |
| 27 | 28 | Khukhmorit | 68 | 73 | Tsagaan-Ovoo |
| 28 | 29 | Bayan-Uul | 69 | 74 | Chuluunkhoroot |
| 29 | 30 | Jargalan | 70 | 75 | Bayan-Uul |
| | 31 | Gaulin | 71 | 76 | Bayandun |
| III | III | BAYANKHONGOR | VII | VII | KHENTII |
| 30 | 32 | Shinejinst | | 77 | Gurvanbayan |
| 31 | 33 | Bayan-Uundur | 72 | 78 | Bayan-Adraga |
| 32 | 34 | Bayanlig | 73 | 79 | Binder |
| 33 | 35 | Bayangovi | 74 | 80 | Batshireet |
| 34 | 36 | Bogd | 75 | 81 | Norovlin |
| 35 | 37 | Jinst | | 82 | Burenkhaan |
| 36 | 38 | Baatsagaan | 76 | 83 | Dadal |
| 37 | 39 | Bayantsagaan | 77 | 9071 | Galshar |
| 38 | 40 | Khureemaraal | 78 | 9072 | Bayan-Ovoo |
| 39 | 41 | Gurvanbulag | VIII | VIII | DUNDGOVI |
| 40 | 42 | Jargalant | 79 | 84 | Ulziit |
| 41 | 43 | Galut | 80 | 85 | Undurshil |
| 42 | 44 | Erdenetsogt | 81 | 86 | Bayanjargalan |
| | 45 | Bayan-Ovoo | 82 | 87 | Adaatsag |
| 43 | 46 | Bayanbulag | 83 | 88 | Erdenedalai |
| 44 | 47 | Buutsagaan | 84 | 9081 | Saikhan-Ovoo |

Notes

- 1) Shaded sum is canceled sum.
- 2) "9* * *" means newly added sum.

List of Sum for Master Plan Study

| Serial No. | Original No. (ID No.) | Name | Serial No. | Original No. (ID No.) | Name |
|------------|--------------------------|-------------------|------------|--------------------------|------------------|
| 85 | 9082 | Khuld | 131 | 131 | Telmen |
| 86 | 9083 | Delgerkhantai | 132 | 132 | Tudevtei |
| IX | IX | UVURKHANGAI | 133 | 133 | Songino |
| 87 | 89 | Bogd | 134 | 134 | Otgon |
| 88 | 90 | Baruunbayan-Ulaan | 135 | 135 | Numrug |
| 89 | 91 | Guchin-Uus | 136 | 136 | Asgat |
| 90 | 92 | Bayan-Undur | 137 | 137 | Bayankhairkhan |
| 91 | 93 | Khairhandulaan | 138 | 138 | Tosontsengel |
| 92 | 94 | Nariinteel | 139 | 9121 | Bayantes |
| 93 | 95 | Bayanteeg | 140 | 9122 | Aldarkhaan |
| X | X | KHUVSGUL | XIII | XIII | BULGAN |
| 94 | 96 | Jargalant | 141 | 139 | Teshig |
| 95 | 97 | Galt | XIV | XIV | UVS |
| 96 | 98 | Shine-Ider | 142 | 140 | Undurkhantai |
| 97 | 99 | Tumurbulag | 143 | 141 | Tsagaankhairkhan |
| 98 | 100 | Burentogtokh | 144 | 142 | Zuunkhantai |
| 99 | 101 | Tsetserleg | 145 | 143 | Khyargas |
| 100 | 102 | Arbulag | 146 | 144 | Baruuntruun |
| 101 | 103 | Bayanzurkh | 147 | 145 | Malchin |
| 102 | 104 | Chandmani-Undur | 148 | 146 | Zuungovi |
| 103 | 105 | Tsagaan-Uur | 149 | 147 | Bukhmunun |
| 104 | 106 | Tsagaan-Uul | 150 | 148 | Zavkhan |
| 105 | 107 | Ulaan-Uul | 151 | 149 | Tes |
| 106 | 108 | Renchinlkhubne | XV | XV | KHOVD |
| 107 | 109 | Tunel | | 150 | Myangad |
| 108 | 110 | Tosontsengel | 152 | 151 | Zereg |
| 109 | 111 | Alag-Erdene | 153 | 152 | Darvi |
| 110 | 112 | Khatgal | 154 | 153 | Altai |
| 111 | 113 | Tsagaannuur | 155 | 154 | Uyench |
| 112 | 114 | Erdenebulgan | 156 | 155 | Bulgan |
| 113 | 9101 | Khankh | 157 | 156 | Tsetseg |
| XI | XI | ARKHANGAI | 158 | 157 | Must |
| 114 | 115 | Khangai | 159 | 158 | Munkhkhairkhan |
| 115 | 116 | Tariat | 160 | 159 | Mankhan |
| 116 | 117 | Tsakhir | 161 | 160 | Chandmani |
| 117 | 9111 | Chuluut | | 161 | Khovd |
| XII | XII | ZAVKHAN | | 162 | Buyant |
| 118 | 118 | Shiluustei | 162 | 163 | Durgun |
| 119 | 119 | Durvljin | 163 | 9151 | Duut |
| 120 | 120 | Yaruu | 164 | 9152 | Erdeneburen |
| 121 | 121 | Erdenekhairkhan | XVI | XVI | BAYAN-ULGII |
| 122 | 122 | Zavkhanmandal | 165 | 164 | Tolbo |
| 123 | 123 | Urgamal | 166 | 165 | Tsagaannuur |
| 124 | 124 | Santmargats | 167 | 166 | Bulgan |
| 125 | 125 | Tsetsen-Uul | 168 | 167 | Deluun |
| 126 | 126 | Ider | 169 | 168 | Altai |
| 127 | 127 | Ikh-Uul | 170 | 169 | Buyant |
| 128 | 128 | Tes | 171 | 170 | Bayannuur |
| 129 | 129 | Tsagaanchuluut | 172 | 171 | Altantsugts |
| 130 | 130 | Tsagaankhairkhan | 173 | 9161 | Nogoonuur |

Notes

- 1) Shaded sum is canceled sum.
- 2) "9* * *" means newly added sum.

List of Materials Kept by Energy Consulting Co., Ltd.

- | | |
|--|--------------------|
| 1. IC memory card | 3 nos. |
| 2. IC memory card reader with RS-232C cable | 3 nos. |
| 3. Data collection program (Disk1 and Disk2) | 1 set |
| 4. Daily & monthly table compiling program (Disk1 and Disk2) | 1 set |
| 5. Measuring condition data file in one diskette | 1 set |
| 6. Photovoltaic panel for spare | 3 pieces |
| 7. Damaged battery and unused battery due to the damaged one | 2 nos. (one each). |

List of Major Materials Kept by each Sum Center

- | | |
|--|-------|
| 1. Maintenance tool | 1 set |
| 2. Digital tester | 1 no. |
| 3. Analog tester | 1 no. |
| 4. Handle for winch of the wind turbine | 1 no. |
| 5. Handle for furling of the wind turbine | 1 no. |
| 6. Power cable XLPE 35 sq.mm 3 cores (delivered later) | 90 m |
| 7. Power cable XLPE 25 sq.mm 2 cores (delivered later) | 60 m |
| 8. Power cable XLPE 38 sq.mm 3 cores (for Bayan-Undur) | 80 m |
| 9. Power cable XLPE 22 sq.mm 2 cores (for Adaatsag & Tariat) | 80 m |

end



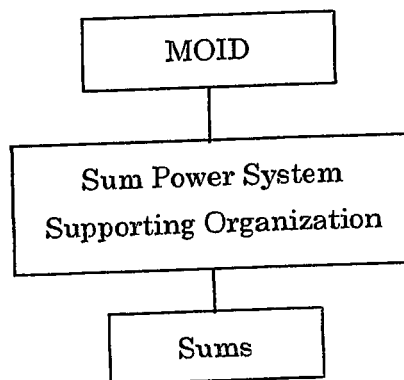
06

MINUTES OF MEETING
FOR
THE MASTER PLAN STUDY FOR RURAL POWER SUPPLY BY RENEWABLE ENERGY
IN
MONGOLIA

The Master Plan Study Team (the Team) of the Japan International Cooperation Agency (JICA), which is headed by Mr. Yoshitomo WATANABE, arrived in Mongolia on October 15, 1999, and will leave on October 29, 1999. During their stay in Mongolia, the Team submitted the Progress Report - 2 to the Ministry of Infrastructure Development (MOID), hold technology transfer seminar at the three Pilot Plant sum centers and had the meeting with the officials concerned of MOID on the Progress Report - 2.

In the meeting, the Team and MOID confirmed the following matters.

1. **Target Sum Centers of the Master Plan** : The final target sum centers for the Master Plan Study were decided as indicated in Attachment-1, which are the same sum centers mentioned in the minutes of meeting dated July 9, 1999.
2. **Management System** : Regarding the management system for the power supply in the sum centers mentioned in the Section 5.8.4 of Part I, MOID proposed the following conceptual structure and the Team agreed with that.



Regarding MOID functions mentioned in the Section 5.8.5 of Part I, the following functions are transferred to the functions of the Sum Power System Supporting Organization.

- 1) Policy making for electricity tariff
- 2) Construction of facilities

(Handwritten initials)

(Handwritten initials)

3. **Privatization** : MOID briefed the Team on the draft privatization plan and its policy, and explained that it took a long time for this privatization to affect the power supply of the sum centers.
4. **Power Supply System** : The basic concept of power supply system for the sum centers in the stages of year 2005, 2010 and 2015, which is mentioned in the Section 5.4 of Part I and its image is shown in the Fig. I.5.4-1, was agreed by MOID.
5. **Communication System** : The basic concept of communication system for the management of power supply in the sum centers in the stages of year 2005, 2010 and 2015, which is mentioned in the Section 5.8.11 of Part I and its image is shown in the Fig. I.5.8-2, was agreed by MOID.
6. **Distribution System** : The basic concept of distribution system of the sum centers in the stages of year 2005, 2010 and 2015, which is mentioned in the Section 5.7 of Part I and its image is shown in the Figs. I.5.7-1 to I.5.7-3, was agreed by MOID.
7. **Sum Centers for Grid Connection** : The following sum centers are excluded from the potential sum centers for transmission line extension listed in the Section 5.5 of Part I and they are examined as sums with isolated power source. Then, the total number of potential sum centers for transmission line extension is twelve.

| ID No. | Sum Name | Aimag Name |
|--------|----------------|--------------|
| 41 | Gurvanbulag | Bayankhongor |
| 42 | Jargalant | Bayankhongor |
| 50 | Zag | Bayankhongor |
| 71 | Khalkhgol | Dornod |
| 74 | Chuluunkhoroot | Dornod |
| 101 | Tsetserleg | Khuvsgul |
| 9101 | Khankh | Khuvsgul |

Note: There is no possibility for connection to the central grid from the sum centers of ID No. 41, 42 and 50. It is difficult to import the power from Russia or China to the sum centers of ID No. 71, 74, 101 and 9101.

8. **Mimi-hydro Power Generation** : Mimi-hydro power generation is studied and planned at Munkhkhairkhan of Khovd Aimag and Baruuntruun of Uvs Aimag as mentioned in the Section 5.6.4 of Part I.
9. **Demand Forecast** : MOID will inform the team, if they have, of their comments on the demand forecast stated in the Chapter 4 of Part I by November 10, 1999.

10. Others : MOID requested the Team to submit the Interim and Draft Final Reports one month before their arrival in Ulaanbaatar to keep the time for detailed examination on the reports.

MOID will prepare the place and necessary arrangement for the technology transfer seminar No.2 to be held by the Team in Ulaanbaatar in the next site study period, February 25 to March 10, 2000, and also send the invitation for the seminar to the person concerned.

October 27, 1999

Ulaanbaatar, Mongolia

渡辺芳知.

Mr. Yoshitomo Watanabe
Team Leader
Nippon Koei Co., Ltd.



Mr. R. Bud
Director General
Integrated Policy and Strategic Planning
Department
Ministry of Infrastructure Development

List of Sum for Master Plan Study

| Serial No. | Original No. (ID No.) | Name | Serial No. | Original No. (ID No.) | Name |
|------------|--------------------------|--------------|------------|--------------------------|----------------|
| | | UMNUGOVI | 45 | 48 | Bumbugur |
| I | I | | | 49 | Ulziit |
| 1 | 1 | Bayandalai | | 50 | Zag |
| 2 | 2 | Bayan-Ovoo | 46 | | |
| 3 | 3 | Bulgan | IV | IV | DORNOGOVI |
| 4 | 4 | Gurvantes | 47 | 51 | Erdene |
| 5 | 5 | Mandal-Ovoo | 48 | 52 | Delgerekh |
| 6 | 6 | Manlai | 49 | 53 | Zamiin-Uud |
| 7 | 7 | Noyon | 50 | 54 | Mandakh |
| 8 | 8 | Nomgon | 51 | 55 | Saikhandulaan |
| 9 | 9 | Sevrei | 52 | 56 | Khatanbulag |
| 10 | 10 | Khanbogd | 53 | 57 | Khuvsgul |
| 11 | 11 | Tsogt-Ovoo | 54 | 9041 | Ulaanbadrakh |
| 12 | 12 | Khurmen | V | V | SUKHBAATAR |
| 13 | 13 | Tsogttsetsii | 55 | 58 | Ongon |
| II | II | GOVI-ALTAI | 56 | 59 | Dariganga |
| 14 | 14 | Erdene | 57 | 60 | Naran |
| 15 | 15 | Tsogt | 58 | 61 | Bayandelger |
| 16 | 16 | Chandmani | 59 | 62 | Erdenetsagaan |
| 17 | 17 | Altai | 60 | 63 | Sukhbaatar |
| | 18 | Delger | 61 | 64 | Tumentsovt |
| 18 | 19 | Taishir | 62 | 65 | Tuvshinshiree |
| 19 | 20 | Bugat | 63 | 66 | Uulbayan |
| 20 | 21 | Tseel | 64 | 67 | Munkhkhaan |
| 21 | 22 | Tugrug | | 68 | Burensovt |
| 22 | 23 | Sharga | VI | VI | DORNOD |
| 23 | 24 | Tonkhil | 65 | 69 | Matad |
| 24 | 25 | Darvi | | 70 | Sumber |
| 25 | 26 | Khaliun | 66 | 71 | Khalkh gol |
| 26 | 27 | Biger | 67 | 72 | Khulunbuir |
| 27 | 28 | Khukhmorit | 68 | 73 | Tsagaan-Ovoo |
| 28 | 29 | Bayan-Uul | 69 | 74 | Chuluunkhoroot |
| 29 | 30 | Jargalan | 70 | 75 | Bayan-Uul |
| | 31 | Gandui | 71 | 76 | Bayandun |
| III | III | BAYANKHONGOR | VII | VII | KHENTII |
| 30 | 32 | Shinejinst | | 77 | Gurvanbayan |
| 31 | 33 | Bayan-Undur | 72 | 78 | Bayan-Adraga |
| 32 | 34 | Bayanlig | 73 | 79 | Binder |
| 33 | 35 | Bayangovi | 74 | 80 | Batshireet |
| 34 | 36 | Bogd | 75 | 81 | Norovlin |
| 35 | 37 | Jinst | | 82 | Burenkhaan |
| 36 | 38 | Baatsagaan | 76 | 83 | Dadal |
| 37 | 39 | Bayantsagaan | 77 | 9071 | Galshar |
| 38 | 40 | Khureemaral | 78 | 9072 | Bayan-Ovoo |
| 39 | 41 | Gurvanbulag | VIII | VIII | DUNDGOVI |
| 40 | 42 | Jargalant | 79 | 84 | Ulziit |
| 41 | 43 | Galut | 80 | 85 | Undurshil |
| 42 | 44 | Erdenetsogt | 81 | 86 | Bayanjargalan |
| | 45 | Bayan-Ovoo | 82 | 87 | Adaatsag |
| 43 | 46 | Bayanbulag | 83 | 88 | Erdenedalai |
| 44 | 47 | Buutsagaan | 84 | 9081 | Saikhan-Ovoo |

Notes

- 1) Shaded sum is canceled sum.
- 2) "9***" means newly added sum.

List of Sum for Master Plan Study

| Serial No. | Original No. (ID No.) | Name | Serial No. | Original No. (ID No.) | Name |
|------------|--------------------------|-------------------|------------|--------------------------|------------------|
| 85 | 9082 | Khuld | 131 | 131 | Telmen |
| 86 | 9083 | Delgerkhangai | 132 | 132 | Tudevtei |
| IX | IX | UVURKHANGAI | 133 | 133 | Songino |
| 87 | 89 | Bogd | 134 | 134 | Otgon |
| 88 | 90 | Baruunbayan-Ulaan | 135 | 135 | Numrug |
| 89 | 91 | Guchin-Uс | 136 | 136 | Asgat |
| 90 | 92 | Bayan-Undur | 137 | 137 | Bayankhairkhan |
| 91 | 93 | Khairhandulaan | 138 | 138 | Tosontengel |
| 92 | 94 | Nariinteel | 139 | 9121 | Bayantes |
| 93 | 95 | Bayanteeg | 140 | 9122 | Aldarkhaan |
| X | X | KHUVSGUL | XIII | XIII | BULGAN |
| 94 | 96 | Jargalant | 141 | 139 | Teshig |
| 95 | 97 | Galt | XIV | XIV | UVS |
| 96 | 98 | Shine-lder | 142 | 140 | Undurkhangai |
| 97 | 99 | Tumurbulag | 143 | 141 | Tsagaankhairkhan |
| 98 | 100 | Burentogtokh | 144 | 142 | Zuunkhangai |
| 99 | 101 | Tsetserleg | 145 | 143 | Khyargas |
| 100 | 102 | Arbulag | 146 | 144 | Baruuntruun |
| 101 | 103 | Bayanzurkh | 147 | 145 | Malchin |
| 102 | 104 | Chandmani-Undur | 148 | 146 | Zuungovi |
| 103 | 105 | Tsagaan-Uur | 149 | 147 | Bukhmurun |
| 104 | 106 | Tsagaan-Uul | 150 | 148 | Zavkhan |
| 105 | 107 | Ulaan-Uul | 151 | 149 | Tes |
| 106 | 108 | Renchinlkhunbe | XV | XV | KHOVD |
| 107 | 109 | Tunel | | 150 | Myangad |
| 108 | 110 | Tosontengel | 152 | 151 | Zereg |
| 109 | 111 | Alag-Erdene | 153 | 152 | Darvi |
| 110 | 112 | Khatgal | 154 | 153 | Altai |
| 111 | 113 | Tsagaannuur | 155 | 154 | Uyench |
| 112 | 114 | Erdenebulgan | 156 | 155 | Bulgan |
| 113 | 9101 | Khankh | 157 | 156 | Tsetseg |
| XI | XI | ARKHANGAI | 158 | 157 | Must |
| 114 | 115 | Khangai | 159 | 158 | Munkhairkhan |
| 115 | 116 | Tariat | 160 | 159 | Mankhan |
| 116 | 117 | Teakhir | 161 | 160 | Chandmani |
| 117 | 9111 | Chuluut | | 161 | Khovd |
| XII | XII | ZAVKHAN | | 162 | Buyant |
| 118 | 118 | Shiluustei | 162 | 163 | Durgun |
| 119 | 119 | Durvuljin | 163 | 9151 | Duut |
| 120 | 120 | Yaruu | 164 | 9152 | Erdeneburen |
| 121 | 121 | Erdenehairkhan | XVI | XVI | BAYAN-ULGII |
| 122 | 122 | Zavkhanmandal | 165 | 164 | Tolbo |
| 123 | 123 | Urgamal | 166 | 165 | Tsagaannuur |
| 124 | 124 | Santmargats | 167 | 166 | Bulgan |
| 125 | 125 | Tsetsen-Uul | 168 | 167 | Deluun |
| 126 | 126 | Ider | 169 | 168 | Altai |
| 127 | 127 | Ikh-Uul | 170 | 169 | Buyant |
| 128 | 128 | Tes | 171 | 170 | Bayannuur |
| 129 | 129 | Tsagaanchuluut | 172 | 171 | Altantsugts |
| 130 | 130 | Tsagaankhairkhan | 173 | 9161 | Nogoonuur |

Notes

1) Shaded sum is canceled sum.

2) "9***" means newly added sum.

MINUTES OF MEETING
FOR
THE MASTER PLAN STUDY FOR RURAL POWER SUPPLY BY RENEWABLE ENERGY
IN
MONGOLIA

The Master Plan Study Team (the Team) of the Japan International Cooperation Agency (JICA), which is headed by Mr. Yoshitomo WATANABE, arrived in Mongolia on February 25, 2000, and will leave on March 10, 2000. During their stay in Mongolia, the Team submitted the Interim Report to the Ministry of Infrastructure Development (MOID), visited the three Pilot Plant sum centers, held Technology Transfer Seminar-2 and had the meeting with the officials concerned of MOID on the Interim Report.

In the meeting, the Team and MOID confirmed the following matters.

1. **Target Sum Centers of the Master Plan :** The following Sum centers were excluded from the target Sum centers for the Master Plan Study. So the number of target Sum centers is 167.

| ID No. | Sum Name | Aimag Name |
|--------|--------------|-------------|
| 88 | Erdenedalai | DUNDGOVI |
| 9081 | Saikhan-Ovoo | DUNDGOVI |
| 92 | Bayan-Undur | UVURKHANGAI |
| 9101 | Khankh | KHUVSGUL |
| 116 | Tariat | ARKHANGAI |
| 9152 | Erdeneburen | KHOVD |

Note: Khankh was already connected to the grid of Russia. The other Sum centers are to be connected to the grid by the Government of Mongolia. The budgetary arrangement for the transmission lines has been taken in the national budget of the year 2000.

The final target sum centers for the Master Plan Study were decided as indicated in Attachment-1.

2. **Demand Forecast :** The Team explained the method and result of the demand forecast which are mentioned in the Chapter 8 in the Interim Report. MOID basically agreed with the method and result of demand forecast.
3. **Power Supply System :** The basic concept of power supply system for the Sum



centers in the stages of year 2005, 2010 and 2015, which is mentioned in the Section 10.4 through 10.7 of Part I, was agreed by MOID.

4. **Distribution System** : The basic concept of distribution system of the sum centers in the stages of year 2005, 2010 and 2015, which is mentioned in the Section 10.8 of Part I, was agreed by MOID.
5. **Communication System** : The basic concept of communication system for the management of power supply in the sum centers in the stages of year 2005, 2010 and 2015, which is mentioned in the Section 10.9.2 of Part I, was agreed by MOID.
6. **Operation and Maintenance** : Proposal for the operation and maintenance of power supply in the Sum centers, which is mentioned in the Section 12.3 of Part I, was basically accepted by MOID.
7. **Pilot Plants after Taking Over** : The Team requested MOID to carefully take care the Pilot Plants and continue the meteorological observation after the Pilot Plant would be taken over in July 2000.
8. **Comments on Report** : The comments made by MOID in the meeting on the Interim Report shall be incorporated in the Draft Final Report. Further examination of the Interim Report will be made by MOID and MOID will send the comments to the team by the middle of April 2000, if any.
The points that the Team want to ask MOID to check or confirm are mentioned in the Attachment-2.
9. **Others** : Zamiin-Uud (ID No. 53) is connected to the grid of China via 10 kV line. However, the transmission capacity of the line is not sufficient for the winter load. Then the power supply system of Zamiin-Uud is re-planned and shown in the Draft Final Report.

March 9, 2000

Ulaanbaatar, Mongolia

渡辺芳知

Mr. Yoshitomo Watanabe
Team Leader
Nippon Koei Co., Ltd.

Long

Mr. R. Bud
Director General
Integrated Policy and Strategic Planning
Department
Ministry of Infrastructure Development

List of Sum for Master Plan Study

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|------------|--------------------------|--------------|------------|--------------------------|----------------|
| 1 | I | UMNUGOVI | 45 | 48 | Bumbugur |
| 1 | 1 | Bayandalai | | 49 | Ulziit |
| 2 | 2 | Bayan-Ovoo | 46 | 50 | Zag |
| 3 | 3 | Bulgan | IV | IV | DORNOGOVI |
| 4 | 4 | Gurvantes | 47 | 51 | Erdene |
| 5 | 5 | Mandal-Ovoo | 48 | 52 | Delgerekh |
| 6 | 6 | Manlai | 49 | 53 | Zamiin-Uud |
| 7 | 7 | Noyon | 50 | 54 | Mandakh |
| 8 | 8 | Nomgon | 51 | 55 | Saikhandulaan |
| 9 | 9 | Sevrei | 52 | 56 | Khatanbulag |
| 10 | 10 | Khanbogd | 53 | 57 | Khuvsgul |
| 11 | 11 | Tsogt-Ovoo | 54 | 9041 | Ulaanbadrakh |
| 12 | 12 | Khurmen | V | V | SUKHBAATAR |
| 13 | 13 | Tsogttsetsii | 55 | 58 | Ongon |
| II | II | GOVI-ALTAI | 56 | 59 | Dariganga |
| 14 | 14 | Erdene | 57 | 60 | Naran |
| 15 | 15 | Tsogt | 58 | 61 | Bayandelger |
| 16 | 16 | Chandmani | 59 | 62 | Erdenetsagaan |
| 17 | 17 | Altai | 60 | 63 | Sukhbaatar |
| | 18 | Delger | 61 | 64 | Tumentsogt |
| 18 | 19 | Taishir | 62 | 65 | Tuvshinshree |
| 19 | 20 | Bugat | 63 | 66 | Uulbayan |
| 20 | 21 | Tseel | 64 | 67 | Munkhkhaan |
| 21 | 22 | Tugrug | | 68 | Burentsogt |
| 22 | 23 | Sharga | VI | VI | DORNOD |
| 23 | 24 | Tonkhil | 65 | 69 | Matad |
| 24 | 25 | Darvi | | 70 | Sumber |
| 25 | 26 | Khaliun | 66 | 71 | Khalk gol |
| 26 | 27 | Biger | 67 | 72 | Khulunbuir |
| 27 | 28 | Khukhmorit | 68 | 73 | Tsagaan-Ovoo |
| 28 | 29 | Bayan-Uul | 69 | 74 | Chuluunkhoroot |
| 29 | 30 | Jargalan | 70 | 75 | Bayan-Uul |
| | 31 | Guulin | 71 | 76 | Bayandun |
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| 32 | 34 | Bayanlig | 73 | 79 | Binder |
| 33 | 35 | Bayangovi | 74 | 80 | Batshireet |
| 34 | 36 | Bogd | 75 | 81 | Norovlin |
| 35 | 37 | Jinst | | 82 | Burenkhaan |
| 36 | 38 | Baatsagaan | 76 | 83 | Dadal |
| 37 | 39 | Bayantsagaan | 77 | 9071 | Galshar |
| 38 | 40 | Khureemaral | 78 | 9072 | Bayan-Ovoo |
| 39 | 41 | Gurvanbulag | VIII | VIII | DUNDGOVI |
| 40 | 42 | Jargalant | 79 | 84 | Ulziit |
| 41 | 43 | Galuut | 80 | 85 | Undurshil |
| 42 | 44 | Erdenetsogt | 81 | 86 | Bayanjargalan |
| | 45 | Bayan-Ovoo | 82 | 87 | Adaatsag |
| 43 | 46 | Bayanbulag | | 88 | Erdenedalai |
| 44 | 47 | Buutsagaan | | 9081 | Saikhhan-Ovoo |

Notes

- 1) Shaded sum is canceled sum.
- 2) "9* * *" means newly added sum.

List of Sum for Master Plan Study

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|------------|--------------------------|-------------------|------------|--------------------------|------------------|
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| 84 | 9083 | Delgerkhangai | 127 | 132 | Tudevtei |
| IX | IX | UVURKHANGAI | 128 | 133 | Songino |
| 85 | 89 | Bogd | 129 | 134 | Otgon |
| 86 | 90 | Baruunbayan-Ulaan | 130 | 135 | Numrug |
| 87 | 91 | Guchin-Us | 131 | 136 | Asgat |
| | 92 | Bayan-Undur | 132 | 137 | Bayankhairkhan |
| 88 | 93 | Khairhandulaan | 133 | 138 | Tosontsengel |
| 89 | 94 | Nariinteel | 134 | 9121 | Bayantes |
| 90 | 95 | Bayanteeg | 135 | 9122 | Aldarkhaan |
| X | X | KHUVSGUL | XIII | XIII | BULGAN |
| 91 | 96 | Jargalant | 136 | 139 | Teshig |
| 92 | 97 | Galt | XIV | XIV | UVS |
| 93 | 98 | Shine-Ider | 137 | 140 | Undurkhangai |
| 94 | 99 | Tumurbulag | 138 | 141 | Tsagaankhairkhan |
| 95 | 100 | Burentogtokh | 139 | 142 | Zuunkhangai |
| 96 | 101 | Tsetserleg | 140 | 143 | Khyargas |
| 97 | 102 | Arbulag | 141 | 144 | Baruuntruun |
| 98 | 103 | Bayanzurkh | 142 | 145 | Malchin |
| 99 | 104 | Chandmani-Undur | 143 | 146 | Zuungovi |
| 100 | 105 | Tsagaan-Uur | 144 | 147 | Bukhmurun |
| 101 | 106 | Tsagaan-Uul | 145 | 148 | Zavkhan |
| 102 | 107 | Ulaan-Uul | 146 | 149 | Tes |
| 103 | 108 | Renchinlkhunbe | XV | XV | KHOVD |
| 104 | 109 | Tunel | | 150 | Myangad |
| 105 | 110 | Tosontsengel | 147 | 151 | Zereg |
| 106 | 111 | Alag-Erdene | 148 | 152 | Darvi |
| 107 | 112 | Khatgal | 149 | 153 | Altai |
| 108 | 113 | Tsagaannuur | 150 | 154 | Uyench |
| 109 | 114 | Erdenebulgan | 151 | 155 | Bulgan |
| | 9101 | Khankh | 152 | 156 | Tsetseg |
| XI | XI | ARKHANGAI | 153 | 157 | Must |
| 110 | 115 | Khangai | 154 | 158 | Munkkhaikhan |
| | 116 | Tariat | 155 | 159 | Mankhan |
| 111 | 117 | Tsakhir | 156 | 160 | Chandmani |
| 112 | 9111 | Chuluut | | 161 | Khovd |
| XII | XII | ZAVKHAN | | 162 | Buyant |
| 113 | 118 | Shiluustei | 157 | 163 | Durgun |
| 114 | 119 | Durvuljin | 158 | 9151 | Duut |
| 115 | 120 | Yaruu | | 9152 | Erdeneburen |
| 116 | 121 | Erdenekhairkhan | XVI | XVI | BAYAN-ULGII |
| 117 | 122 | Zavkhanmandal | 159 | 164 | Tolbo |
| 118 | 123 | Urgamal | 160 | 165 | Tsagaannuur |
| 119 | 124 | Santmargats | 161 | 166 | Bulgan |
| 120 | 125 | Tsetsen-Uul | 162 | 167 | Deluun |
| 121 | 126 | Ider | 163 | 168 | Altai |
| 122 | 127 | Ikh-Uul | 164 | 169 | Buyant |
| 123 | 128 | Tes | 165 | 170 | Bayannuur |
| 124 | 129 | Tsagaanchuluut | 166 | 171 | Altantsugts |
| 125 | 130 | Tsagaankhairkhan | 167 | 9161 | Nogoonuur |

Notes

1) Shaded sum is canceled sum.

2) "9* * *" means newly added sum.

The Issues That Require Special Attention**Location:**

Part I Chapter 7

| | | |
|-------------|---|--------|
| 7.6..... | Power Demand and Tariff System | 1.7-15 |
| 7.6.3 | Impact of Meter Rated Tariff Collection on Power Demand | 1.7-17 |

In this section, we stresses the importance of meter rating to encourage energy saving and also establish a fair financial burden on every user. Though some argues that the small energy consumption under meter-rated tariff is due to power theft, we believe that the energy saving is much larger. In any case, it is not possible to measure the loss of power without complete installation of meters to the users.

Location: CHAPTER 8POWER DEMAND FORECAST FOR SUMS 1.8-1

It is necessary to understand that there is lack of current demand data. Therefore, we had to estimate the current demand first. The demand is divided into household, BHN sectors and others. The household demand is estimated by the demand function which was calculated from a statistical analysis of the sampled households. The function includes the ownership of electric appliances for two reasons. First, the statistical analysis proved these variables are the only significant variables. Other variables such as income, ownership of cattle, family size, etc did not show any significance. Second, the data obtained through the Inventory Survey on income is not as reliable as the data on the ownership of electric appliances.

The demand estimate is based on the use of wattmeters. This should lead to the reduction in power demand. Such reduction in power demand will improve the evaluation of the Project because the required capacity will be reduced accordingly while the benefits will remain the same.

Please refer to the attached sheet used for our presentation for the brief summary of the impact of wattmeters and also the demand estimation.

Location: 8.2.4 Estimation of Load Factor (Load Curve) 1.8-5

We believe that 0.2 for the estimated load factor is justifiable.

PB.

| | | |
|-----------------------------------|--|---------------|
| Location: CHAPTER 12 | MANAGEMENT AND MAINTENANCE PLAN | I.12-1 |
| 12.1 | Outline..... | I.12-1 |
| | 12.1.2 Establishment of Management Principles..... | I.12-2 |
| | 12.3.3 Maintenance Reinforcement Program | I.12-8 |
| 12.4..... | Suggestions for Electricity Tariff System | I.12-13 |

Here we emphasize the importance of the self-reliance principle of the sum management to improve the efficiency and effectiveness of the power supply management. However, the sum needs to rely on subsidies or grants to install new power supply capacities. Thus the privatization is not a viable option, either. The way we suggest is to screen the sums for the installation of new capacities as described "pre-qualification" in 12.3.3. This will not only test the resolve of the sums to improve management but also encourage competition among the sums. Since the year 2005 program includes the installation of wattmeters to every user, the investment will be wasted without the introduction of the meter system, which is the core of the pre-qualification.

Location:

| | | |
|-------------|--|---------|
| 12.3.4..... | Management Organization of Sum Centers | I.12-12 |
|-------------|--|---------|

It is necessary that there will be an independent organization to assist and supervise the isolated sum power supplies.

CHAPTER 13 ECONOMIC AND FINANCIAL ANALYSIS I.13-1

The financial evaluations all show negative returns on the investments except for the mini-hydro project. The economic returns on the investments should be positive to justify even a grant-based project. However, the present analysis of the year 2005 program shows negative returns, we expect that the returns on the investments will be all positive after correcting some mismatches of the cost allocations and further refinements of the proposed systems. Some of such improvements are;

- 1) Exclusion of meteorological measurement, data communication from evaluation of the year 2005 program since they serve all other stages and other purposes.
- 2) Exclusion of wattmeters from the evaluation of BHN targeted programs of the year 2005.




- 3) Evaluation of surplus energy generated by the renewable energy sources to be applied for water heating or pumping.

Check List for PV power generation

1. Selection criteria and classification for PV system
(From page I.10-22 to page I.10-26)
2. From the point of View of Project evaluation (Section 10.14-1)
To select the applicable Sum centers for year 2010 and 2015 require more detail data for this meteorological observation system be recommended.
3. As the TACIS has established the three Pilot Plants at School and Hospital (Except Sum office) as below which will over lap the power supply plan of JICA for year 2005.
 - (a) ID No. 33, Bayan-Undur of Bayanhongor Aimag
 - (b) ID No. 36, Bogd of Bayanhongor Aimag and
 - (c) ID No. 91, GuchinUs of Uvurkhangai Aimag.

Check list for wind generation

1. Selection criteria and classification criteria for wind system.
(p I.10-25 to p I.10-27)
2. 10.14 Project Evaluation
(2) From wind power generation system of view.
The 2010 and 2015 projects will have to be reexamined on the basis of the monitoring results obtained using precision weather monitoring system until 2005. (p I.10-59 (2))

ps



MINUTES OF MEETING
FOR
THE MASTER PLAN STUDY FOR RURAL POWER SUPPLY BY RENEWABLE ENERGY
IN
MONGOLIA

The Master Plan Study Team (the Team) of the Japan International Cooperation Agency (JICA), which is headed by Mr. Yoshitomo WATANABE, arrived in Mongolia on July 29, 2000, and will leave on August 9, 2000. During their stay in Mongolia, the Team submitted the Draft Final Report to the Ministry of Infrastructure Development (MOID), held Technology Transfer Seminar-3 and had the meeting with the officials concerned of MOID on the Draft Final Report.

The Team and MOID mutually confirmed the following as the result of meeting.

1. **Submission of Draft Final Report:** The team submitted ten sets of the Draft Final Report, which consists of Summary, Main Report and Data Book, to MOID on July 31, 2000. MOID acknowledged receipt of the Report. The team explained the contents of the Report and which was basically accepted by MOID.
2. **Comments on Report :** The comments on Draft Final Report made by MOID in the meeting shall be incorporated in the Final Report. Further examination on the Report will be made by MOID and MOID will send the comments to the Team by August 24, 2000 through FAX or E-mail, if any.
3. **Final Report :** The Team will prepare the Final Report, incorporating the comments of MOID, and submit it to JICA Tokyo headquarters by September 12, 2000. JICA forward 30 sets of the Final Report to MOID, or the competent authorities in case of reorganization, by September 29, 2000.
4. **Disclosure to Public :** MOID confirmed that the Final Report can be treated as "Disclosure to Public".
5. **Transfer of Pilot Plants and Equipment :** The Team handed over to MOID a letter signed by JICA Managing Director informing of JICA's acceptance of transfer of the Pilot Plants and equipment used for the Study; the transfer had been requested by MOID.
Following the principle mentioned in the letter, the Team transferred to MOID three Pilot Plants and all the equipment listed the attachment (MOID's letter for the acceptance).



6. **Pilot Plants after Transfer** : The Team requested MOID to take care of the Pilot Plants and continue the meteorological observation after this transfer. MOID agreed with the request.
7. **Disposal of Exhausted Battery** : A huge number of batteries will be used in the Sum Centers to which a renewable power source is applied in the stages of 2005 and 2010. The disposal of these batteries after being exhausted will become serious problem from an environmental point of view if the Government of Mongolia doesn't impose any legal control on such disposal. The Team requested MOID to take necessary arrangement for the legal regulation on disposal of exhausted batteries. MOID agreed with the request.
8. **Management Organization** : MOID understood and agreed with the proposal for the management organization of power supply to Sum center.
9. **Title of Final Report** : MOID requested the Team to change the title of Final Report so as to include the words like "Power Supply in Sum Centers". The Team will convey this request to JICA Tokyo headquarters.

August 7, 2000
Ulaanbaatar, Mongolia

渡辺 芳知
Mr. Yoshitomo Watanabe
Team Leader
Nippon Koei Co., Ltd.

Mr. R. Bud
Director General
Integrated Policy and Strategic Planning
Department
Ministry of Infrastructure Development

МОНГОЛ УЛСЫН
ДЭД БҮТЭЦИЙН
ХӨГЖЛИЙН
ЯАМ

MINISTRY OF
INFRASTRUCTURE
DEVELOPMENT
MONGOLIA

Date: 04.08.2000
No

Ulaanbaatar-210616

Phone: 310603

Fax: (976-1) 310612

To: Keisuke MIHARA
Managing Director
Mining & Industrial Development Study Department
Japan International Cooperation Agency
TOKYO, JAPAN


Dear Sir,

Subject: MASTER PLAN STUDY FOR RURAL POWER SUPPLY BY RENEWABLE
ENERGY IN MONGOLIA
Acceptance of Pilot Plants and Equipment

With reference to the above, we are please to accept the transfer of the Plot Plants and the study equipment upon the completion of the Draft Final Report. The Pilot Plants and the equipment were used by the Study Team, the Sums and the Mongolian counterparts during the study period. The list of the confirmed details of the transfer is attached herewith.

Finally we would like to extend our heartfelt thanks to JICA for your cooperation and assistance given to us and we look forward to the continued cooperation in the future.

Yours sincerely,


R.SUNDUI
Deputy Director
Integrated Policy and Strategic Planning
Department

Attachment: As stated above



LIST OF EQUIPMENT PROVIDED BY JICA

| No. | Items | Qty |
|---|---|---------|
| Pilot Plants | | |
| 1 | Photovoltaic Generation Unit | 3 units |
| | (1) Photovoltaic cell module | 3 units |
| | (2) Array protection unit | 6 nos. |
| | (3) Base frame | 3 units |
| 2 | Wind Generating Unit | 3 units |
| | (1) Wind generator | 3 sets |
| | (2) Steel tower | 3 units |
| 3 | Inverter Unit | 3 units |
| | (1) Inverter | 3 nos. |
| | (2) Control panel | 3 nos. |
| 4 | Outdoor Cubicle | 3 units |
| | (1) Outdoor type cubicle | 3 nos. |
| 5 | Data Processing Unit | 3 units |
| | (1) Data acquisition unit | 3 units |
| | (2) Data processing unit | 3 units |
| 6 | Battery Unit | 3 units |
| | (1) Battery | 3 units |
| | (2) Base frame | 3 units |
| 7 | Meteorological Observation Unit | 3 units |
| | (1) Wind vane and anemometer | 3 sets |
| | (2) Pyranometer | 3 sets |
| | (3) Sunshine hour meter | 3 sets |
| | (4) Barometer | 3 sets |
| | (5) Thermometer | 6 sets |
| 8 | Distribution and Wiring Materials | 3 sets |
| Materials and Equipment for Site Investigation | | |
| 1 | Global Positioning System (GPS) | 2 sets |
| 2 | Walkie-talkie with 12V DC adapter | 2 sets |
| 3 | Laptop computer with data base software | 2 sets |
| 4 | Printer | 2 set |
| 5 | Tent | 5 sets |
| 6 | Sleeping bag | 12 nos. |
| 7 | Cooking sets | 2 sets |
| 8 | Copy machine | 1 sets |

Appendix-2 Member of Study Team

**The Master Plan Study for Rural Power Supply
by Renewable Energy in Mongolia**

Member of the Study Team

1. Team Leader / Power Supply Planner : Yoshitomo WATANABE
2. Demand Estimator / Power Supply System Specialist : Tomoyasu FUKUCHI
3. Solar Power Planner : Deepak B. BISTA
4. Wind Power Planner : Tsutomu DEI
5. Tariff Analyst / Economic and Financial Analyst : Hiroshi NISHIMAKI
6. Social and Organization Analyst : Kiyofumi TANAKA
7. Coordinator : Kazuyuki TADA (1998 & 2000) Norio UEDA (1999)