# Voltage Profile Improvement of KR Power Network Using Reactive Power Control

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***Abstract* — The growth of demand and so the generation causes the Kurdistan Regional (KR) network to be heavily loaded which lead to high drop voltages across the lines and cause the bus voltage at the some nodes to be under the permissible level. In this study, PSS™E software has been used to simulate and analyse the KR network. The worst voltage profile has been used for year 2013. The load flow analysis results appeared that the voltage at most nodes are below the permissible value (for example the lowest voltage is at Soran bus 0.8629 pu). To improve the voltage profile SVC facilities are proposed. To apply SVC device; weak buses are found and the SVC device is placed at this bus. Results show great improvement in the voltage profile (for example the lowest voltage after application of SVC is 0.9423 pu), reduce losses and also increase the lines' capacity.**

***Keywords-component; Volatge profile, SVC, weak bus.***

## I. INTRODUCTION

With growing up of a power system and increasing demand, voltage sag will decrease and become serious problem. When load is increased, more reactive power is required and if there is shortage of reactive power in the network, it is expected voltage sag will be decrease. To improve voltage level injection of reactive power in network is required; FACTS controller could be a good solution to support network with required reactive power [1, 2].

Shortage of reactive power is due to consumer's low power factor, losses of reactive power in transmission system or insufficient generation of reactive power from power source itself.

The rapid developments of power electronics give opportunities to produce new power system devices that can be perform better with higher efficiency than existing system. Flexible AC Transmission System (FACTS) technology have been proposed and implemented. FACTS devices can be effectively used to control power flow (active power and reactive power), voltage regulation and improvement of transient stability in the power system [3, 4]. Both Static Var Compensator (SVC) and Static Synchronous Compensator (STATCOM) are two types of FACTS devices which are mainly used to control reactive power and voltage stability [5, 6]. In this paper, SVC has been used to improve voltage profiles in KR power network (Figure 1).

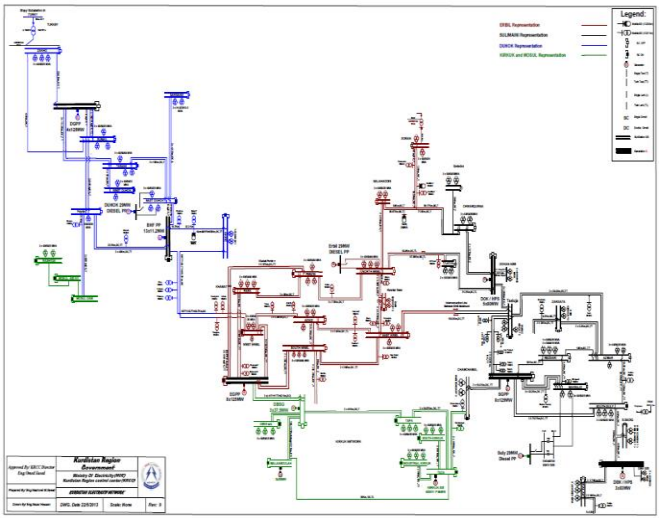


Figure 1 KR Power Network

## II. SIMULATION OF KR NETWORK

Daily generation data for all power plants have been collected for the year 2013 because these data are useful to dedicate (date) the peak load for each season. Daily load curve have been plotted for each peak loads to know exact time that maximum load happened and used as input data to simulator.

Siemens Power System Simulator (PSS™E Version 31) had been used as main program. Five scenarios have been build up in simulator, after running of simulator it shows worst scenario is at summer season and there are 31.6% of substations their voltage drop under allowable rang (according to the Iraqi Grid Code for 132kV is ±10%) [7]. List of buses that have voltage problems are shown in Figure 2 and more details are shown in Appendix I.

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    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(tm)E    WED, AUG 20 2014  12:29
KRG - NETWORK
TOWANA S.

BUSES WITH VOLTAGE GREATER THAN 1.1000:

  BUS# X-- NAME --X BASKV AREA  V(PU)  V(KV)      BUS# X-- NAME --X BASKV AREA  V(PU)  V(KV)

                                    * NONE *

BUSES WITH VOLTAGE LESS THAN 0.9000:

  BUS# X-- NAME --X BASKV AREA  V(PU)  V(KV)      BUS# X-- NAME --X BASKV AREA  V(PU)  V(KV)
 10000 AQRA        132.00    1 0.9000 118.80    10500 PALSAN MOB  132.00    1 0.8969 118.39
 10501 AQR JOIN    132.00    1 0.8999 118.79    13040 EERB1       132.00    2 0.8992 118.69
 13060 ERBP1       132.00    2 0.8982 118.57    13070 PRZEN       132.00    2 0.8966 118.35
 13081 ERBN2       132.00    2 0.8965 118.34    13090 NEWERB      132.00    2 0.8970 118.41
 13100 SLDN        132.00    2 0.8815 116.36    13110 SORAN2      132.00    2 0.8629 113.91
 13504 QALAT MOB   132.00    2 0.8989 118.66    13510 HAMREN MOB  132.00    2 0.8995 118.73
 13511 KAREZAN MOB 132.00    2 0.8996 118.75    13520 SAFEN MOB   132.00    2 0.8962 118.29
 13521 BAKUR MOB   132.00    2 0.8967 118.36    13522 HIWA MOB    132.00    2 0.8965 118.34
 13523 MALAOMER MOB132.00    2 0.8894 117.40    13524 KASNAZAN MOB132.00    2 0.8977 118.50
 13525 SORAN JOIN1 132.00    2 0.8775 115.83    13526 SORAN JOIN2 132.00    2 0.8784 115.95
 13527 RAWANDUZ MOB132.00    2 0.8658 114.29    13528 KHALIFAN MOB132.00    2 0.8715 115.04
 13529 SPILK MOB   132.00    2 0.8742 115.40    13530 SHAQLAWA MOB132.00    2 0.8812 116.32
 13531 HARIR MOB   132.00    2 0.8786 115.97    13532 AQRA JOIN1  132.00    2 0.8808 116.27
 13533 AQRA JOIN2  132.00    2 0.8818 116.40    14001 CHRK        132.00    3 0.8997 118.76
 14020 QALADZA     132.00    3 0.8887 117.30    15300 DIBIS       132.00    4 0.8814 116.34
```

Figure 2 List of buses their voltages exceeds ±10%

## III. WEAK BUS

The weakest bus is the one that is nearest to experience voltage collapse in the system [8]. In this paper some technics have are used to find the week bus, which are:

### *A. PV and QV Curves*

The PV curve or "nose curve" and QV curve are load flow based analyses used to assess voltage variation when active power and reactive power of load change. PV is one of the method that widely used for stability analysis; it shows how bus voltage affected by variation of active power. By increasing the load at chosen bus bar in the system (other loads are fixed) and getting responses form sources until the system reaches the limit and get crashes. This procedure has to follow for each bus bar in the system that required to be investigated. If the load continuously increases more than maximum active power generation, voltage collapse will happen and the system get blackout. QV analysis shows the sensitivity and variation of bus voltages with respect to reactive power injections or absorptions by loads. Actually, it is a plotting of (V & Q) but it is still by tradition called QV curve. By same procedure QV curve can be plotted and if generation reactive powers exceed limit value (bottom of curve) voltage collapse will happened [8, 9, 10].

### *B. V/Vo Index*

The ratio $V/V_0$ at each bus shows the voltage stability map of the system. V is the bus voltage at certain load obtained from load flow study. Voltages $V_0$ are obtained by solving load flow of the system at an identical state but with all other loads set to zero. This index allows immediate detection of weakest bus and corrective action can be taken to prevent the voltage instability [8, 9].

## IV. SEARCHING FOR WEAK BUS

To find the weakest bus in network same simulator has been used as following;

i. PV Curve: the PSS™E software has capability to show PV analysis for certain buses (maximum 8) at same plot. To find weakest bus, some busses have been selected according to their lowest voltage values as shown in the Figure 3. From the curve it is noticed that voltage collapse will happened at maximum loading of ($\lambda$ =231/100 ➔ 2.31 Pu), and it is indicated that Soran2 bus (13110) is the weakest bus in system.

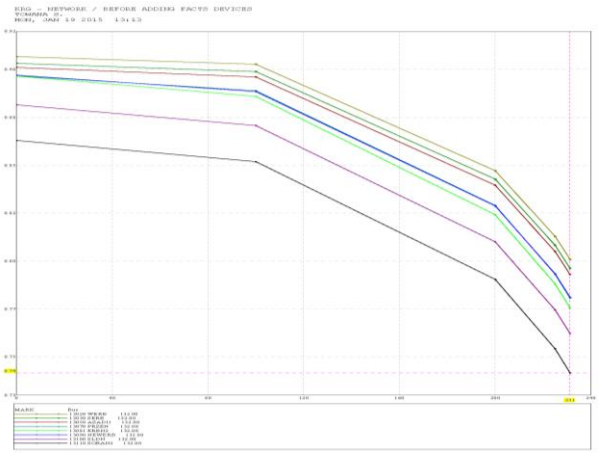


Figure 3 PV curve seeking for weak bus

ii. QV Curve: the PSS™E will draw the relation between Q and V only for a single bus, for that reason this QV analysis have been done for the same 8 worst buses in PV curve analysis and plotted in excel file as shown in Figure 4. It can be illustrated that Soran2 bus (13110) has lowest minimal margin of reactive power respectively; this indicate most critical bus in the system where could be best location to install SVC devices.

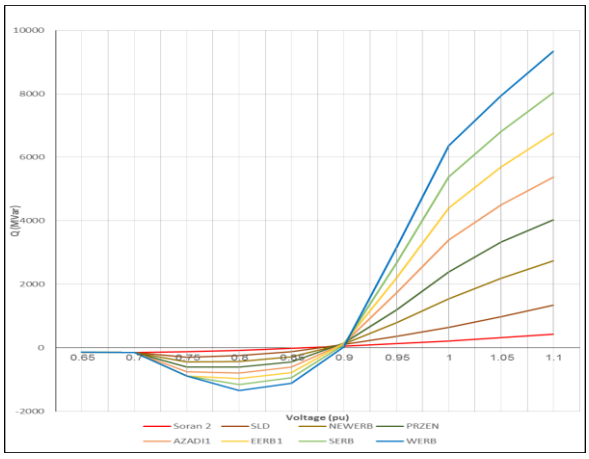



Figure 4 QV curve seeking for weak bus

iii. V/Vo Index: to get this index several times of load flow have been run for loading factor ($\lambda$=0.5 & 1.0) and results are shown in Figure 5. It is noticed that at load factor ($\lambda$=0.5) the results are approximately close to each other but after increasing loading factor up to ($\lambda$=1.0) it can be demonstrated that "Soran2 bus" has the lowest value (0.858).

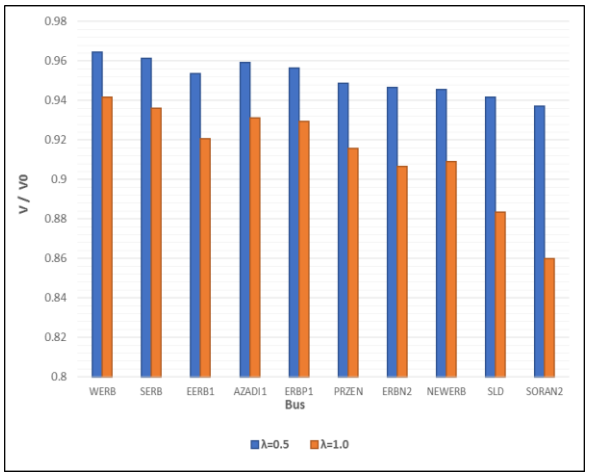
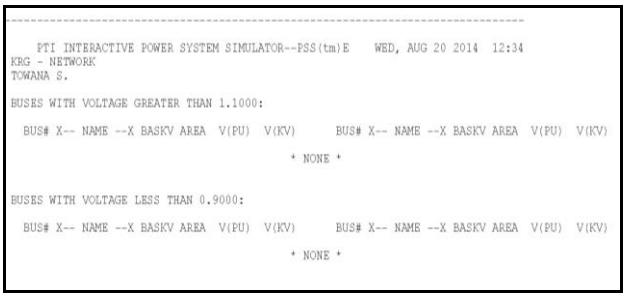



Figure 5 V/Vo index to find for weak bus

## V. RESULTS

PV curve, QV curve and V/Vo index shows "Soran2 bus" is the weakest bus in the network that needs reactive power support to improve its voltage level. SVC has been added at the weak bus "Soran2 bus". The problem of voltage in entire of the network has been solved and their operating voltages are in limit range when SVC device produced 128.5 MVAR. Figure 6 shows a report that the entire network voltage problems have been solved.



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    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(tm)E    WED, AUG 20 2014  12:34
KRG - NETWORK
TOWANA S.

BUSES WITH VOLTAGE GREATER THAN 1.1000:

  BUS# X-- NAME --X BASKV AREA  V(PU)  V(KV)      BUS# X-- NAME --X BASKV AREA  V(PU)  V(KV)

                                    * NONE *

BUSES WITH VOLTAGE LESS THAN 0.9000:

  BUS# X-- NAME --X BASKV AREA  V(PU)  V(KV)      BUS# X-- NAME --X BASKV AREA  V(PU)  V(KV)

                                    * NONE *
```

Figure 6 List of buses after compensation

Results show that:

- Voltage profile: it have been taken before and after adding SVC at each bus in the network. Figure 7 shows the voltage profile before adding SVC. It can be observed how the network is suffering from low voltage when there are many of buses are under minimum allowable voltage (0.9) pu. Figure 8 shows the voltage profile after adding SVC at Soran bus. It can be observed all buses are between minimum and maximum allowable voltage range.

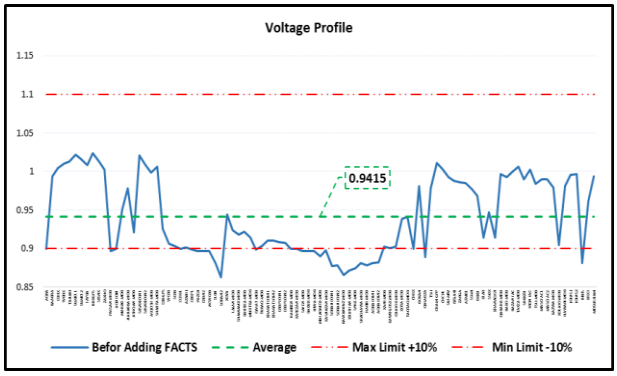



Figure 7 Voltage profile before adding SVC

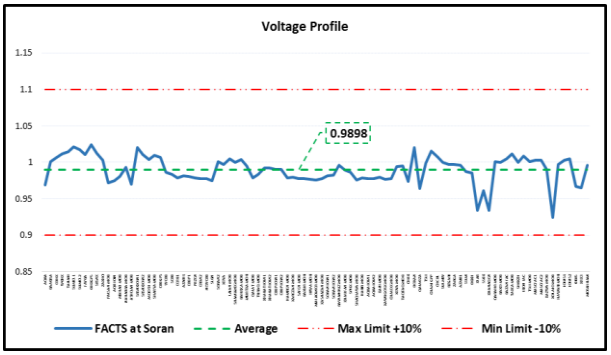
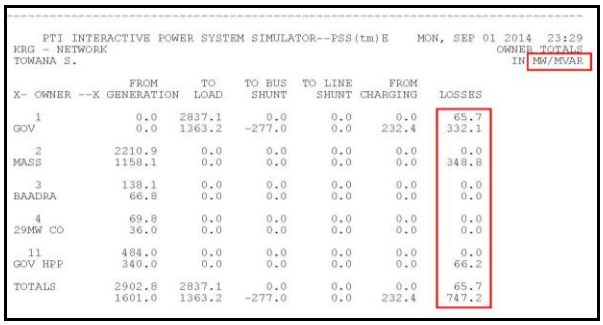



Figure 8 Voltage profile after adding SVC

- Maximum Loading Factor (λ); the maximum loading was equal to 2.31p.u but after adding SVC this value have been increased to 4.0p.u.
- Active and reactive power losses: Figure 9 shows the results Government transmission losses before adding SVC to the network, the total losses in the network (GOV) was 65.7 MW and 332.1 MVAR. But after adding the total losses in the network (GOV) is 57.3 MW and 291.7 MVAR as shown in Figure 10.



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    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(tm)E    MON, SEP 01 2014  23:29
KRG - NETWORK                                                    OWNER TOTALS
TOWANA S.                                                        IN MW/MVAR

                FROM        TO       TO BUS   TO LINE    FROM
X- OWNER --X GENERATION    LOAD      SHUNT     SHUNT  CHARGING    LOSSES

   1              0.0    2837.1        0.0       0.0       0.0      65.7
GOV               0.0    1363.2     -277.0       0.0     232.4     332.1

   2           2210.9       0.0        0.0       0.0       0.0       0.0
MASS           1158.1       0.0        0.0       0.0       0.0     348.8

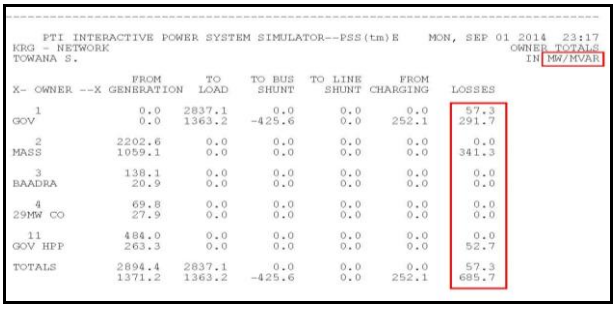
   3            138.1       0.0        0.0       0.0       0.0       0.0
BAADRA           66.8       0.0        0.0       0.0       0.0       0.0

   4             69.8       0.0        0.0       0.0       0.0       0.0
29MW CO          36.0       0.0        0.0       0.0       0.0       0.0

  11            484.0       0.0        0.0       0.0       0.0       0.0
GOV HPP         340.0       0.0        0.0       0.0       0.0      66.2

TOTALS         2902.8    2837.1        0.0       0.0       0.0      65.7
               1601.0    1363.2     -277.0       0.0     232.4     747.2
```

Figure 9 power losses before adding SVC



PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(tm)E MON, SEP 01 2014 23:17
KRG - NETWORK
TOWANA S.

| X- OWNER --X | FROM GENERATION | TO LOAD | TO BUS SHUNT | TO LINE SHUNT | FROM CHARGING | LOSSES |
|---|---|---|---|---|---|---|
| 1 | 0.0 | 2837.1 | 0.0 | 0.0 | 0.0 | 57.3 |
| GOV | 0.0 | 1363.2 | -425.6 | 0.0 | 252.1 | 291.7 |
| 2 | 2202.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| MASS | 1059.1 | 0.0 | 0.0 | 0.0 | 0.0 | 341.3 |
| 3 | 138.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| BAADRA | 20.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 | 69.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 29MW CO | 27.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11 | 484.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GOV HPP | 263.3 | 0.0 | 0.0 | 0.0 | 0.0 | 52.7 |
| TOTALS | 2894.4 | 2837.1 | 0.0 | 0.0 | 0.0 | 57.3 |
| | 1371.2 | 1363.2 | -425.6 | 0.0 | 252.1 | 685.7 |

OWNER TOTALS
IN MW/MVAR

Figure 10 power losses after adding SVC

- VAR Generation: total VAR generations in power plants after adding SVC have been reduced from 1600.4 MVAR to 1371.4 MVAR.

## VI. CONCLUSION

SVC device have been added to the power network and analyzed, from results that obtained it can conclude;

i. Adding SVC device in network will significantly help to improve voltage profile and operate network within the allowable range.

ii. Improving system stability which help to reduce total blackout of network

iii. Active power and reactive power losses in transmission will be decrease.

iv. Transmitting capability of transmission lines will be increase.

v. Generation power plants perform better and their capability of active generation will be increase with deceasing of reactive power generation.

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## Appendix I

Load Flow Analysis before Compensation (Filtered)

PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(tm)E FRI, Mar 11 2016 22:27

KR - NETWORK / BEFORE ADDING FACTS DEVICES BUS DATA

TOWANA S.

S H U N T S

| BUS# | X-- NAME --X | BASKV | CODE | LOADS | FIXED | SWITCHED | VOLT | ANGLE | AREA | ZONE | OWNER |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10000 | AQRA | 132.00 | 1 | 1 | 1 | 0 | 0.89999 | -31.5 | 1 | 10 | 1 |
| 10010 | BAADRA | 132.00 | 2 | 0 | 0 | 0 | 0.99350 | -14.5 | 1 | 10 | 1 |
| 10020 | EDHK | 132.00 | -2 | 1 | 1 | 0 | 1.00395 | -12.9 | 1 | 10 | 1 |
| 10040 | WDHK | 132.00 | 1 | 1 | 1 | 0 | 1.01009 | -12.0 | 1 | 10 | 1 |
| 10050 | TANAHI | 132.00 | 1 | 1 | 1 | 0 | 1.01317 | -11.8 | 1 | 10 | 1 |
| 10060 | SUMEL1 | 132.00 | 1 | 1 | 1 | 0 | 1.02127 | -10.6 | 1 | 10 | 1 |
| 10061 | SUMEL2 | 132.00 | 1 | 1 | 1 | 0 | 1.01625 | -11.3 | 1 | 10 | 1 |
| 10070 | FAYDA | 132.00 | 1 | 1 | 0 | 0 | 1.00777 | -12.5 | 1 | 10 | 1 |
| 10080 | DHKGPS | 132.00 | 1 | 0 | 0 | 0 | 1.02380 | -10.3 | 1 | 10 | 2 |
| 10082 | GDHK1 | 15.000 | 2 | 0 | 0 | 0 | 0.96772 | 27.3 | 1 | 10 | 2 |
| 10083 | GDHK2 | 15.000 | 2 | 0 | 0 | 0 | 0.96756 | 27.4 | 1 | 10 | 2 |
| 10084 | GDHK3 | 15.000 | 2 | 0 | 0 | 0 | 0.96756 | 27.4 | 1 | 10 | 2 |
| 10085 | GDHK4 | 15.000 | 2 | 0 | 0 | 0 | 0.96739 | 27.4 | 1 | 10 | 2 |
| 10086 | GDHK5 | 15.000 | 2 | 0 | 0 | 0 | 1.05848 | 26.0 | 1 | 10 | 2 |
| 10087 | GDHK6 | 15.000 | 2 | 0 | 0 | 0 | 1.05848 | 26.0 | 1 | 10 | 2 |
| 10088 | GDHK7 | 15.000 | 2 | 0 | 0 | 0 | 1.05848 | 26.0 | 1 | 10 | 2 |
| 10089 | GDHK8 | 15.000 | 4 | 0 | 0 | 0 | 1.00000 | 0.0 | 1 | 10 | 2 |
| 10090 | SRSNK | 132.00 | 1 | 1 | 1 | 0 | 1.01279 | -11.8 | 1 | 10 | 1 |
| 10100 | ZAKHO | 132.00 | 1 | 1 | 1 | 0 | 1.00262 | -12.5 | 1 | 10 | 1 |
| 10500 | PALSAN MOB | 132.00 | 1 | 1 | 0 | 0 | 0.89692 | -34.6 | 1 | 10 | 1 |
| 10501 | AQR JOIN | 132.00 | 1 | 0 | 0 | 0 | 0.89991 | -34.1 | 1 | 10 | 1 |
| 10502 | MAHAD MOB | 132.00 | 1 | 1 | 0 | 0 | 0.95127 | -20.2 | 1 | 10 | 1 |
| 10503 | NAHADRA MOB | 132.00 | 1 | 1 | 0 | 0 | 0.97821 | -16.4 | 1 | 10 | 1 |
| 10504 | ASHQAN MOB | 132.00 | 1 | 1 | 0 | 0 | 0.92115 | -25.7 | 1 | 10 | 1 |
| 10510 | SRSNKJOIN1 | 132.00 | 1 | 0 | 0 | 0 | 1.02033 | -11.1 | 1 | 10 | 1 |
| 10511 | SRSNKJOIN2 | 132.00 | 1 | 0 | 0 | 0 | 1.00798 | -12.6 | 1 | 10 | 1 |
| 10512 | ALQOSH MOB | 132.00 | 1 | 1 | 0 | 0 | 0.99828 | -13.8 | 1 | 10 | 1 |
| 10513 | SHARYA MOB | 132.00 | 1 | 1 | 0 | 0 | 1.00664 | -12.6 | 1 | 10 | 1 |
| 13000 | ERBGPS | 132.00 | 1 | 0 | 0 | 0 | 0.92550 | -34.9 | 2 | 13 | 2 |
| 13002 | GERB1 | 15.000 | 3 | 0 | 0 | 0 | 0.92550 | 0.0 | 2 | 13 | 2 |
| 13003 | GERB2 | 15.000 | 2 | 0 | 0 | 0 | 0.96489 | 3.3 | 2 | 13 | 2 |
| 13004 | GERB3 | 15.000 | 2 | 0 | 0 | 0 | 0.96486 | 3.3 | 2 | 13 | 2 |
| 13005 | GERB4 | 15.000 | 2 | 0 | 0 | 0 | 0.96446 | 3.5 | 2 | 13 | 2 |
| 13006 | GERB5 | 15.000 | 2 | 0 | 0 | 0 | 0.96547 | 3.0 | 2 | 13 | 2 |
| 13007 | GERB6 | 15.000 | 2 | 0 | 0 | 0 | 0.96519 | 3.2 | 2 | 13 | 2 |
| 13008 | GERB7 | 15.000 | 2 | 0 | 0 | 0 | 0.96563 | 2.9 | 2 | 13 | 2 |
| 13009 | GERB8 | 15.000 | 2 | 0 | 0 | 0 | 0.96429 | 3.6 | 2 | 13 | 2 |
| 13020 | WERB | 132.00 | 1 | 1 | 1 | 0 | 0.90669 | -36.6 | 2 | 13 | 1 |
| 13030 | SERB | 132.00 | 1 | 1 | 1 | 0 | 0.90319 | -37.2 | 2 | 13 | 1 |
| 13037 | POLTIKS | 132.00 | 4 | 1 | 0 | 0 | 1.00000 | 0.0 | 2 | 13 | 1 |
| 13040 | EERB1 | 132.00 | 1 | 2 | 2 | 0 | 0.89917 | -37.9 | 2 | 13 | 1 |
| 13041 | EERB2 | 132.00 | 4 | 0 | 0 | 0 | 1.00000 | 0.0 | 2 | 13 | 1 |
| 13050 | AZADI1 | 132.00 | 1 | 3 | 1 | 0 | 0.90105 | -37.4 | 2 | 13 | 1 |
| 13051 | AZADI2 | 132.00 | 4 | 0 | 1 | 0 | 1.00000 | 0.0 | 2 | 13 | 1 |
| 13060 | ERBP1 | 132.00 | 1 | 1 | 1 | 0 | 0.89822 | -37.6 | 2 | 13 | 1 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 13070 | PRZEN | 132.00 | 1 | 1 | 1 | 0 | 0.89660 | -38.0 | 2 | 13 | 1 |
| 13080 | ERBN1 | 132.00 | 4 | 0 | 0 | 0 | 1.00000 | 0.0 | 2 | 13 | 1 |
| 13081 | ERBN2 | 132.00 | -2 | 1 | 1 | 0 | 0.89651 | -38.2 | 2 | 13 | 1 |
| 13090 | NEWERB | 132.00 | 1 | 1 | 1 | 0 | 0.89703 | -38.1 | 2 | 13 | 1 |
| 13100 | SLDN | 132.00 | 2 | 1 | 0 | 0 | 0.88151 | -38.3 | 2 | 13 | 1 |
| 13110 | SORAN2 | 132.00 | 2 | 2 | 2 | 0 | 0.86294 | -40.2 | 2 | 13 | 1 |
| 13111 | SORAN1 | 132.00 | 4 | 0 | 0 | 0 | 1.00000 | 0.0 | 2 | 13 | 1 |
| 13130 | KOYA | 132.00 | 1 | 1 | 0 | 0 | 0.94420 | -37.1 | 2 | 13 | 1 |
| 13500 | LAJAN MOB | 132.00 | 1 | 1 | 0 | 0 | 0.92327 | -35.1 | 2 | 13 | 1 |
| 13501 | SHAMAMK MOB | 132.00 | 1 | 1 | 0 | 0 | 0.91796 | -35.7 | 2 | 13 | 1 |
| 13502 | BAHRKA MOB | 132.00 | 1 | 1 | 0 | 0 | 0.92222 | -35.3 | 2 | 13 | 1 |
| 13503 | MURTKA MOB | 132.00 | 1 | 1 | 0 | 0 | 0.91371 | -36.1 | 2 | 13 | 1 |
| 13504 | QALAT MOB | 132.00 | 1 | 1 | 0 | 0 | 0.89891 | -37.8 | 2 | 13 | 1 |
| 13505 | TURAQ MOB | 132.00 | 1 | 1 | 0 | 0 | 0.90378 | -37.0 | 2 | 13 | 1 |
| 13506 | KHABAT JOIN1 | 132.00 | 1 | 0 | 0 | 0 | 0.91020 | -36.6 | 2 | 13 | 1 |
| 13507 | KHABAT JOIN2 | 132.00 | 1 | 0 | 0 | 0 | 0.91019 | -36.6 | 2 | 13 | 1 |
| 13508 | ERBP JOIN1 | 132.00 | 1 | 0 | 0 | 0 | 0.90821 | -36.7 | 2 | 13 | 1 |
| 13509 | ERBP JOIN2 | 132.00 | 1 | 0 | 0 | 0 | 0.90769 | -36.7 | 2 | 13 | 1 |
| 13510 | HAMREN MOB | 132.00 | 1 | 1 | 0 | 0 | 0.89950 | -37.8 | 2 | 13 | 1 |
| 13511 | KAREZAN MOB | 132.00 | 1 | 1 | 0 | 0 | 0.89960 | -37.7 | 2 | 13 | 1 |
| 13520 | SAFEN MOB | 132.00 | 1 | 1 | 0 | 0 | 0.89616 | -38.1 | 2 | 13 | 1 |
| 13521 | BAKUR MOB | 132.00 | 1 | 1 | 0 | 0 | 0.89669 | -38.2 | 2 | 13 | 1 |
| 13522 | HIWA MOB | 132.00 | 1 | 1 | 0 | 0 | 0.89652 | -38.2 | 2 | 13 | 1 |
| 13523 | MALAOMER MOB | 132.00 | 1 | 1 | 0 | 0 | 0.88940 | -38.3 | 2 | 13 | 1 |
| 13524 | KASNAZAN MOB | 132.00 | 1 | 1 | 0 | 0 | 0.89770 | -38.0 | 2 | 13 | 1 |
| 13525 | SORAN JOIN1 | 132.00 | 1 | 0 | 0 | 0 | 0.87748 | -38.6 | 2 | 13 | 1 |
| 13526 | SORAN JOIN2 | 132.00 | 1 | 0 | 0 | 0 | 0.87844 | -38.6 | 2 | 13 | 1 |
| 13527 | RAWANDUZ MOB | 132.00 | 1 | 1 | 0 | 0 | 0.86580 | -39.9 | 2 | 13 | 1 |
| 13528 | KHALIFAN MOB | 132.00 | 1 | 1 | 0 | 0 | 0.87149 | -39.3 | 2 | 13 | 1 |
| 13529 | SPILK MOB | 132.00 | 1 | 1 | 0 | 0 | 0.87421 | -39.0 | 2 | 13 | 1 |
| 13530 | SHAQLAWA MOB | 132.00 | 1 | 1 | 0 | 0 | 0.88118 | -38.1 | 2 | 13 | 1 |
| 13531 | HARIR MOB | 132.00 | 1 | 1 | 0 | 0 | 0.87857 | -38.4 | 2 | 13 | 1 |
| 13532 | AQRA JOIN1 | 132.00 | 1 | 0 | 0 | 0 | 0.88084 | -38.0 | 2 | 13 | 1 |
| 13533 | AQRA JOIN2 | 132.00 | 1 | 0 | 0 | 0 | 0.88182 | -37.9 | 2 | 13 | 1 |
| 13534 | KANI MOB | 132.00 | 1 | 1 | 0 | 0 | 0.90284 | -35.1 | 2 | 13 | 1 |
| 13535 | KAWRGOSK MOB | 132.00 | 1 | 1 | 0 | 0 | 0.90047 | -34.9 | 2 | 13 | 1 |
| 13537 | CHALOK MOB | 132.00 | 1 | 1 | 0 | 0 | 0.90203 | -34.8 | 2 | 13 | 1 |
| 13538 | KOYA MOB | 132.00 | 1 | 1 | 0 | 0 | 0.93833 | -37.3 | 2 | 13 | 1 |
| 13539 | TAQTAQ MOB | 132.00 | 1 | 1 | 0 | 0 | 0.94127 | -37.2 | 2 | 13 | 1 |
| 14001 | CHRK | 132.00 | 1 | 1 | 1 | 0 | 0.89968 | -38.7 | 3 | 14 | 1 |
| 14010 | DOKAN | 132.00 | 1 | 1 | 0 | 0 | 0.98132 | -35.5 | 3 | 14 | 11 |
| 14012 | HDK01 | 13.800 | -2 | 0 | 0 | 0 | 0.95147 | -1.4 | 3 | 14 | 11 |
| 14013 | HDK02 | 13.800 | -2 | 0 | 0 | 0 | 0.95147 | -1.4 | 3 | 14 | 11 |
| 14014 | HDK03 | 13.800 | -2 | 0 | 0 | 0 | 0.95147 | -1.4 | 3 | 14 | 11 |
| 14015 | HDK04 | 13.800 | -2 | 0 | 0 | 0 | 0.95147 | -1.4 | 3 | 14 | 11 |
| 14016 | HDK05 | 13.800 | -2 | 0 | 0 | 0 | 0.95147 | -1.4 | 3 | 14 | 11 |
| 14020 | QALADZA | 132.00 | 1 | 1 | 1 | 0 | 0.88866 | -39.3 | 3 | 14 | 1 |
| 14030 | TSLJ | 132.00 | 1 | 1 | 1 | 0 | 0.97763 | -35.9 | 3 | 14 | 1 |
| 14040 | CHAM GPP | 132.00 | 1 | 0 | 0 | 0 | 1.01100 | -33.4 | 3 | 14 | 2 |
| 14042 | GCHAM1 | 15.000 | 2 | 0 | 0 | 0 | 0.98339 | 0.7 | 3 | 14 | 2 |
| 14043 | GCHAM2 | 15.000 | 2 | 0 | 0 | 0 | 0.97796 | 4.2 | 3 | 14 | 2 |
| 14044 | GCHAM3 | 15.000 | 2 | 0 | 0 | 0 | 0.97796 | 4.2 | 3 | 14 | 2 |
| 14045 | GCHAM4 | 15.000 | 2 | 0 | 0 | 0 | 0.97781 | 4.3 | 3 | 14 | 2 |
| 14046 | GCHAM5 | 15.000 | 2 | 0 | 0 | 0 | 0.97796 | 4.2 | 3 | 14 | 2 |
| 14047 | GCHAM6 | 15.000 | 2 | 0 | 0 | 0 | 0.97781 | 4.3 | 3 | 14 | 2 |
| 14048 | GCHAM7 | 15.000 | 2 | 0 | 0 | 0 | 0.97857 | 3.9 | 3 | 14 | 2 |
| 14049 | GCHAM8 | 15.000 | 2 | 0 | 0 | 0 | 0.97842 | 4.0 | 3 | 14 | 2 |
| 14060 | CHCHL | 132.00 | 1 | 1 | 0 | 0 | 1.00330 | -33.9 | 3 | 14 | 1 |
| 14070 | SULMW | 132.00 | -2 | 1 | 0 | 0 | 0.99234 | -35.2 | 3 | 14 | 1 |
| 14080 | RZGARI | 132.00 | 1 | 1 | 1 | 0 | 0.98824 | -35.6 | 3 | 14 | 1 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 14100 | ZARGA | 132.00 | 1 | 1 | 0 | 0 | 0.98579 | -35.8 | 3 | 14 | 1 |
| 14110 | AZMR1 | 132.00 | 1 | 1 | 1 | 0 | 0.98447 | -36.0 | 3 | 14 | 1 |
| 14120 | SSLM | 132.00 | 1 | 1 | 1 | 0 | 0.97718 | -36.8 | 3 | 14 | 1 |
| 14130 | DBKH | 132.00 | 1 | 1 | 0 | 0 | 0.96860 | -36.6 | 3 | 14 | 11 |
| 14136 | HDP1 | 13.800 | -2 | 0 | 0 | 0 | 0.92209 | 1.0 | 3 | 14 | 11 |
| 14137 | HDP2 | 13.800 | -2 | 0 | 0 | 0 | 0.92209 | 1.0 | 3 | 14 | 11 |
| 14138 | HDP3 | 13.800 | -2 | 0 | 0 | 0 | 0.92209 | 1.0 | 3 | 14 | 11 |
| 14140 | KLAR | 132.00 | 1 | 1 | 1 | 0 | 0.91397 | -43.6 | 3 | 14 | 1 |
| 14150 | SSDK | 132.00 | 1 | 1 | 0 | 0 | 0.94719 | -38.5 | 3 | 14 | 1 |
| 14170 | KHANAQEN | 132.00 | 1 | 1 | 0 | 0 | 0.91423 | -43.8 | 3 | 14 | 1 |
| 14500 | QARAHR MOB | 132.00 | 1 | 1 | 0 | 0 | 0.99641 | -34.4 | 3 | 14 | 1 |
| 14501 | BAKO MOB | 132.00 | 1 | 1 | 0 | 0 | 0.99220 | -35.2 | 3 | 14 | 1 |
| 14502 | BAZAN FAC | 132.00 | 1 | 1 | 0 | 0 | 0.99930 | -34.5 | 3 | 14 | 1 |
| 14503 | TAKEA MOB | 132.00 | 1 | 1 | 0 | 0 | 1.00646 | -33.8 | 3 | 14 | 1 |
| 14504 | SHRKZH | 132.00 | 1 | 1 | 0 | 0 | 0.99001 | -35.3 | 3 | 14 | 1 |
| 14505 | IRON FAC | 132.00 | 1 | 1 | 0 | 0 | 1.00219 | -34.1 | 3 | 14 | 1 |
| 14506 | TSLJ MOB | 132.00 | 1 | 1 | 0 | 0 | 0.98374 | -35.4 | 3 | 14 | 1 |
| 14507 | MASCFAC1 | 132.00 | 1 | 1 | 0 | 0 | 0.98981 | -35.0 | 3 | 14 | 1 |
| 14508 | MASCFAC2 | 132.00 | 1 | 1 | 0 | 0 | 0.98981 | -35.0 | 3 | 14 | 1 |
| 14509 | KAZWA MOB | 132.00 | 1 | 1 | 0 | 0 | 0.97938 | -36.5 | 3 | 14 | 1 |
| 14510 | KALAR MOB | 132.00 | 1 | 1 | 0 | 0 | 0.90440 | -44.5 | 3 | 14 | 1 |
| 14511 | HAWARI MOB | 132.00 | 1 | 1 | 0 | 0 | 0.98126 | -36.0 | 3 | 14 | 1 |
| 14512 | JOINS1 | 132.00 | 1 | 0 | 0 | 0 | 0.99513 | -34.8 | 3 | 14 | 1 |
| 14513 | JOINS2 | 132.00 | 1 | 0 | 0 | 0 | 0.99675 | -34.7 | 3 | 14 | 1 |
| 15300 | DIBIS | 132.00 | 1 | 1 | 0 | 0 | 0.88140 | -38.4 | 4 | 15 | 1 |
| 15310 | KRK3 | 132.00 | 1 | 1 | 0 | 0 | 0.96118 | -36.7 | 4 | 15 | 1 |
| 16001 | MOSULDAM | 132.00 | 1 | 1 | 0 | 0 | 0.99359 | -14.3 | 5 | 16 | 1 |