CHAPTER FIVE

CONCLUSION AND FUTURE RECOMMENDATION

5.1 Conclusion

There are countries that are taking initiatives to switch from using fossil fuels to solar applications. These countries form a pool called the G-20 countries which have taken the global leadership to adopt renewable resources of energy. Germany is one of the G-20 countries that has switched its energy needs to approximately 38% to solar, and aims to go completely stop its dependency on nuclear and replace it with solar by the year 2050 [9]. Similarly, most of the countries have abundant solar potential and can take a lesson from Germany.

5.2. Recommendation

It is suggested that future plans may help the country to fight poverty and lack of awareness by:

I. Further studies to increase the efficiency and reliability of these grid on systems in addition to cost decrement.

II. Develop the mentality of the usage of renewable energy technologies.

III. Increase the capacity of the PV generation.

IV. Apply this project in as many cities and villages as possible in Sudan to increase the degree of fuel independence.

5.2.1. Recommended Preventive Maintenance Works

It is recommended that preventive inspection and maintenance works are carried out every six to twelve months. The PV modules require routine visual inspection for signs of damage, dirt build-up or shade encroachment. Solar PV system fixtures must be checked for corrosion. This is to ensure that the solar PV system is safely secured.

The following table shows some recommendations on the preventive maintenance works on the components and equipment, and the corresponding remedial actions to be carried out by qualified personnel.

Table 5.1: recommendations on the preventive maintenance

Component/equipment	Description	Remedy/ Action
1_Pv modules	• Check for dust/debris on surface of PV module • Check for physical damage to any PV module • Check for loose cable terminations between PV modules, PV arrays, etc. • Check for cable conditions.	• Wipe clean. Do not use any solvents other than water • Recommend replacement if found damaged • Retighten connection • Replace cable if necessary
2_Pv inverter	• Check functionality, Recommend automatic disconnection upon loss of grid power supply • Check ventilation condition • Check for loose cable terminations	• Recommend replacement if functionality fails • Clear dust and dirt in ventilation system • Tighten connection

	• Check for abnormal operating temperature.	• Recommend replacement
3_Cabling	• Check for cable condition i.e. wear and tear • Check cable terminals for burnt marks, hot spots or loose connections	• Replace cable if necessary • Tighten connections or recommend replacement
4_Junction box	• Check cable terminals e.g. wear and tear or loose connections • Check for warning notices • Check for physical damage	• Tighten or recommended replacement • Replace warning notice if necessary • Recommend replacement
5_Means of isolation	• Check functionality replacement	• Recommend
6_Earthing of solar pv system	• Check earthling cable conditions • Check the physical earthing connection • Check continuity of the cable to electrical earth recommend replacement	• Recommend replacement • Tighten connection • Troubleshoot or recommend replacement

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APPENDIX A

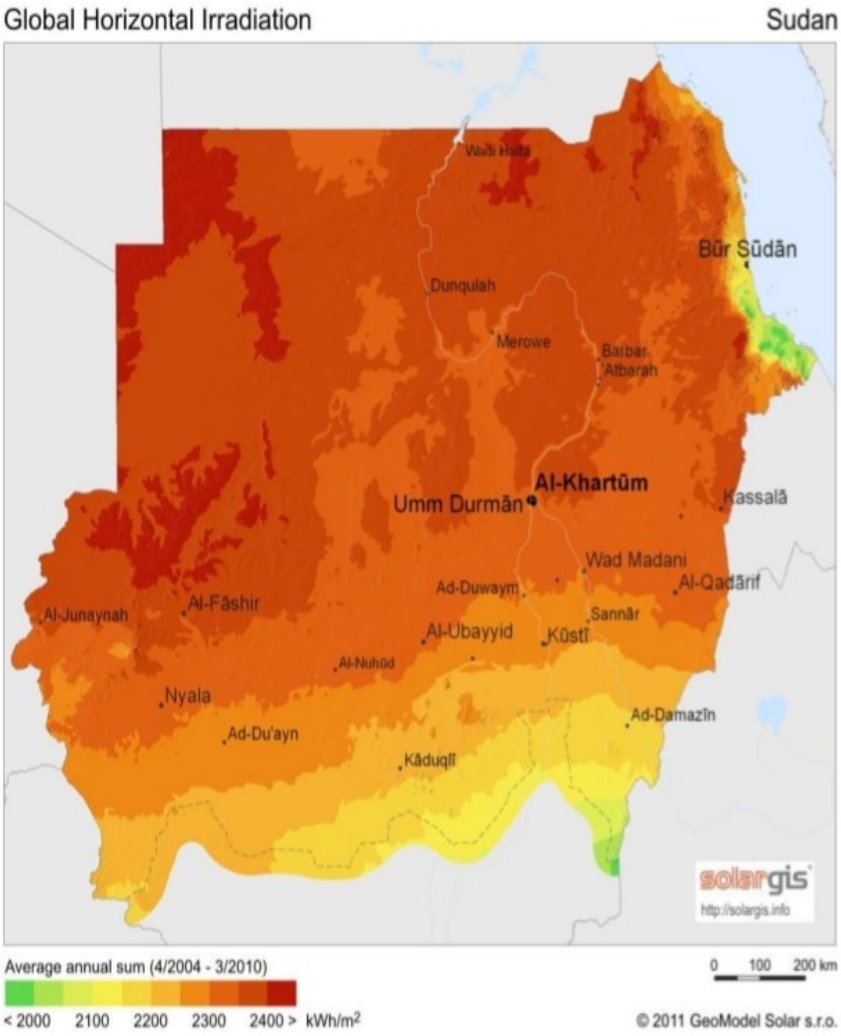

Figure A.1 SUDAN Horizontal Irradiation Map

APPENDIX B

B.1 PV Module Specifications:

The PV module selected in this project is a poly-crystalline PV module type QQ.cell by Q.cell Technology Co.Ltd.

Figure B.1: Q.cell Solar Technology PV Module

B.2.Inverter Specification

TableB.2.Technical specifications data for inverter:

Model	1 Kw	2 Kw	3 Kw	4 Kw	5 Kw
Rated output power	1000 W	2000 W	3000 W	4000 W	5000 W
PV input(DC)					
Max PV power	1000 W	2000 W	4000 W	4000 W	6000 W
Max PV array open circuit voltage	145 V dc	145 V dc	145 V dc	145 V dc	145 V dc
MPPT range @operating voltage	15vdc~115vdc	30vdc ~115vdc	60vdc~115vdc	60vdc~115vdc	60vdc~115vdc
Number of MPP tracker	1	1	1	1	2
Grid tie operation					
Grid output (AC)					
Nominal output current	4.3 A	8.7 A	13 A	17.4 A	21.7 A

Nominal output voltage	220/230/240 vac
Feed in grid voltage range	195.5~253 vac @India 184~267 @Germany
Feed in grid frequency range	49~51Hz@India 47.5~51.5Hz@Germany
Power factor range	>0.99
Maximum conversion efficiency	90%

Table 5.2: Data load and impedance of modified grid:

Load	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
P	920	490	896	459	469	198	300	198	820
Q	230	170	223	529	175	27.931	15.869	26.324	100
Line: from	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
TO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
R	0.1233	0.014	0.7463	0.6984	1.9831	0.9053	2.0552	4.7953	5.3434
X	0.4127	0.605	1.205	0.6084	1.7276	0.7886	1.164	2.716	3.0264
Xc (ohms)	-	-	-	17.3056	21.632	57.685	34.61	-	-
Capacitor (KVAr)	-	-	-	1000	800	300	500	-	-