PERSONAL INFORMATION

Mustafa Demirol

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& Aliağa, İzmir /TURKEY
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Sex Male | Date of birth 30/01/1984 | Nationality Turkish | Military Obligation Done in Cyprus | Spouse Profession Msc. Industrial Engineer

PERSONAL STATEMENT

Career Objectives:
• Obtain a Project Management position in the field of turnkey projects, in fully electrical installation or Conventional Power Generation, Transport and Distribution, Smart Grid Applications, Renewable energy Investment, or a position in supervision. Rankable work experience in power utilities, planning agencies, regulators, renewable energy project developers or renewable energy technology suppliers.
• Deep understanding of LV, MV, HV EHV Electrical system related data center, Hi-Tech industrial facilities such as petrochemical, harbour, labarotories.
• Good understanding of "Smart-grid" technologies for transmission and distribution including experience not limited of the following technologies: power control systems, energy management systems, substation automation system

Project Management. LV, HV & EHV Plant operation, maintenance. Network policies, procedures, safety rules & working practices. Network analysis and modelling Power plant, HV/MV substation design comply with NEC, EN, IEEE and IEC standards. Commissioning of utility-scale Thermal, Waste Heat, Waste&Landfill Biomass, CCHP, Cogeneration, Wind, PV power plants and supervisory according to suitable standarts (EN, IEC, ASME, ASTM, IEEE),

• Strong organizational, research, and oral presentation skills.
• Proven ability to work in a team and intercultural environment, with minimal supervision.
• Willing to travel to a range of all the related countries,

COMPETENCIES
• ***Knowledge and Experience in Development Arena*** - • ***Integrative Skills*** - • **Electrical Utility and Energy Sector Technologies** - • **Electrical Utility and Energy Sector High Level Engineering Software Technologies** - • **Energy Sector Risk Management** - • **Energy Policy, Strategy and Institutions** - • **Renewable Energy** - Direct experience with depth in at least one area: solar, geothermal; wind; hydropower; biomass; waste heat, low carbon strategies.

WORK EXPERIENCE

MENTOR GROUP PROJECT MANAGEMENT
Engineering Consultancy

Kördere Str. Çavdar Apt. No: 6/3
34724 Kızıltoprak / Istanbul / Turkey
P:+ +90 216 449 16 33
(January 2018 - …)

Project Name :1- **Roketsan HiTech Lab**. 2- **Data Center**: Inspection on behalf of Roketsan(Lalahan/ANK). ~150m$

The Data center project is class TIER 3. BICSI 002 Data Centre Design and Implementation Best Practices EN50600 Sections 1 and 2.1 to 2.5. To satisfy the requirements for Class F3 diversity there must be 2 power paths to the load. It has been confirmed that all equipment in the standard cabinets will have two PSU's so theserows can have dual supplies, one of which is supplied from the UPS, the other direct from the utility/generator.

- The supercomputer equipment has single source power supply connections, so should be fed from either supply with a change-over device. Cooling equipment should also be supplied from either source with a change-over device. As described below the cooling equipment will consist of fans, pumps and cooling towers which can and should be supported on the UPS to prevent thermal runaway. All main components should have N+1 resilience, where N is the number of components required to support the design load + 1 redundant component. The power required for the initial and future equipment configurations is shown in the capacity.
- **Computer room 1: Internet (Roketsan)**

Room to be separated by solid partition or cage from other computer rooms, Up to twenty 80cm wide x 120cm deep x 42u cabinets. Each 5kW air cooled, dual redundant single phase power supplies.

- **Computer room 2: Intranet 1 (ITS)**

Room to be separated by solid partition or cage from other computer rooms Up to forty 80cm wide x 120cm deep x 42u cabinets. Each 5kW air cooled, dual redundant single phase power supplies.

- **Computer room 3: Intranet 2 (RSNET)**

Room to be separated by solid partition or cage from other computer rooms Up to twenty 80cm wide x 120cm deep x 42u cabinets. Each 5kW air cooled, dual redundant single phase power supplies. Option to upgrade in future to accommodate

- **Computer room 4: YBH System Room**

Room to be separated by solid partitions from other computer rooms. Two supercomputer “pods” of cabinets and cooling laid out and with power and water cooling to SGI® ICE™ XA in E-cells Site Planning Guide, plus additional D2 cabinet as summarised in the diagram below

ITS (HiTech Labs) project is industrial labrotories including, fire protection, telephone communication, audience voiceover and dubbing,emergency system, UPS, CCTV, access system,

- Studying on Method of Statement –Terms and Condition: HV/MV/LV Electrical System Audit for The End User in terms of electrical system safety operation and maintenance comply with IEC 60364; IEC 60909, IEC 61936, IEEE 80
- Installation of 20 km underground MV and 1 km fiber optic cabling
- Installation of 16x1,25MVA Transformer, RMU and kioks manufactured by Schenider
- Installation of SCADA system and its auxliaries to operate and monitor all site
- Site modellling of the 154kV, 34,5kV, 10,5kV, 0,4kV system by means of ETAP 12.6 software in order to perform short circuit, realy coordination of B63, S42, S82,T80, T20 type Sepam Relays, UGS reliability and load flow studies.
- Reviewing ITP's and Method Statements submitted by contractors
- Witnessing and reviewing static and dynamic electrical test such as CT, VT, Cables, Relay, Transformer, CB, MCCB, Impendance Loop Test, Earth Protection Test, Earth fault loop impedance, Earth electrode resistance, Operation of residual current operated device, Prospective short circuit (Ip) at the mains intake and each distribution board, Earth fault loop impedance (Zs) at the mains intake and each distribution board, Continuity of protective conductor, Continuity of ring final circuit conductors, Insulation resistance, Flash over tests of site built panels.
- Witnessing and reviewing test result of FAT & SAT test procedures for Static Transfer Switch, ATS, UPS, MDP,, SMDP, transformers, high/medium voltage circuit breaker, cables etc.
- Carrying out infrastructure test inspections for SCADA implementation, fire-fighting, and electrical lines based on relevant British Standards, IEC, and Euro Codes.
- Managing electrical commissioning activities.
- Recording non-conformances / non-compliances, Non Conformance Report (NCR)

WORK EXPERIENCE

CGR GROUP Engineering Consultancy

59-61 High Street, Kingston Upon Thames, Surrey. Kt1 1LQ LONDON UK
P:+44 (0) 2084397588
(March2017-January2018)

CULLEN GRUMMITT & ROE
Chartered Civil Engineers
Consulting Engineers – Harbour, Civil & Structural

Project Name : İzmir Aegean Gateway: Inspection for **APM Terminal** site works for HV, LV System about 40MVA utility. ~400m$

- Substantial completion signed on 13 September 2017 and closed on 15 January 2018.
- Studying on Method of Statement –Terms and Condition: HV/MV/LV Electrical System Audit for The End User in terms of electrical system safety operation and maintenance comply with IEC 60364; IEC 60909, IEC 61936, IEEE 80
- Installation of 80 km underground 12 kV and 6 km fiber optic cabling
- Installation of 30x1,25MVA Transformer, RMU and kioks manufactured by Schenider
- Installation of SCADA system and its auxliaries to operate and monitor all site
- Monitoring and inspection all electrical works on a daily basis
- Site modellling of the 154kV, 34,5kV, 10,5kV, 0,4kV system by means of ETAP 12.6 software in order to perform short circuit, realy coordination of B63, S42, S82,T80, T20 type Sepam Relays, UGS reliability and load flow studies.
- Reviewing ITP's and Method Statements submitted by contractors
- Witnessing and reviewing static and dynamic electrical test such as CT, VT, Cables, Relay, Transformer, CB, MCCB, Impendance Loop Test, Earth Protection Test, Earth fault loop impedance, Earth electrode resistance, Operation of residual current operated device, Prospective short circuit (Ip) at the mains intake and each distribution board, Earth fault loop impedance (Zs) at the mains intake and each distribution board, Continuity of protective conductor, Continuity of ring final circuit conductors, Insulation resistance, Flash over tests of site built panels.

- Witnessing and reviewing test result of FAT & SAT test procedures for transformers, high/medium voltage circuit breaker, cables etc.
- Carrying out infrastructure test inspections for SCADA implementation, fire-fighting, and electrical lines based on relevant British Standards, IEC, and Euro Codes.
- Managing electrical commissioning activities.
- Recording non-conformances / non-compliances, Non Conformance Report (NCR), PDN, LDN

WORK EXPERIENCE
(Burea Veritas
August 2016-
March 2017)

Inspection of WPP, PV, biogas power plant and MV&LV V Electrical Facilities as *a freelance*.
Audit of electrical equipment FAT &SAT test procedures for transformers, high/medium voltage circuit breaker, cables etc.

- 6+4 MW PV Power plant has been inspected.
- 12 MW PV Power Plant bankable Feasibility has been studied and concluded.
- Studying on Method of Statement : HV/MV/LV Electrical System Audit for The End User in terms of electrical system safety operation and maintenance comply with IEC 60364(and sub titles); IEC 60909, IEEE 1584, IEEE C.37

WORK EXPERIENCE
(Bestepe Energy
Consultancy Engineering
Limited Co.
September2016 -March
2017)

Senior Consultant Electrical Engineer;

- MV&LV Electrical Facilities Audit procedure with regard to ISO EN 17020 IEC 60364
- Biogas Power plant (Çorum Çerkeş Biogas PP Project Management, Kayseri Yeşilhisar Biogas PP Project Consultancy,)
- In Addition to these experiences, I have been carried out project and design requirements include MPPT, inverter, cable etc. for PV power plants more or less 50 MW which is 10 differrent province in Turkey. Small and medium scale PV power plant (Uğurludağ 1-2, Hasanpaşa, Yeşilhisar, Viranşehir)
- Cogeneration power plant feasibility studes have been performed for the Hospital Complex in Siirt Province
- Grid impact studies Atacora Solar SA 25MWp solar PV Project in Benin [GReenwish Partners Co & Greenheart Power Africa, with respect o SBEE, Natitingou SS] , **On Behalf Of Burea Veritas**
- Tender Bidding Procedures
- Feasibility Studies

WORK EXPERIENCE

(MENR 2007-2016)
Electrical System

Audit&design of Electrical installation of different type of electrical systems *(medium voltage switchgear & High Voltage cable, generators, power transformers, medium voltage circuit breaker, Low voltage switchgear and protection systems)* Commissioning and Maintenance for all electro mechanical works.

Review all the drawings for approval. Electrical design and detailed engineering for oil & gas and petrochemical plants. Through knowledge in preparation of design concepts, verification of basic engineering documents, various electrical equipments datasheets & specifications, electrical load list, hv & lv cable sizing calculation, lighting calculation, earthing and lightning calculation(IEEE 80, IEC 61936, IEC 62305) transformer sizing calculation, diesel generator set sizing calculation, capacitor sizing calculation, ac & dc profile schedule, electrical power & control cable schedule, line diagram & schematic diagram, interconnection diagram, cable tray & trench layout, earthing layout, lighting & power layout, hazardous layout, material take-off, detailed procurement specification of various electrical equipments, technical support for construction works and procurement activities, review of vendor technical drawings & documents, short circuit study, load flow analysis study, motor acceleration study, power factor study & relay co-ordination study by ETAP.

Follow up of the project plan and activity carried out by planning department. Organizing and managing the inspection with the clients and end users as required. Responsible for testing and fault locating in the electrical networks. Electrical routine and type test for the low, medium, high and extra high voltage cable according to the international standard. Witnessing of upgraded protection systems testing & commissioning. Products Manufacturers: SIEMENS, ABB, MICOM, SEL etc. Relays: Generator Protection Relay Parameters, Line Differential, Transformer Differential, O/C & Earth fault, CBF, OV/UV. Supervising /

Witnessing the construction activities and ensuring the work as per approved Design and Implementation of National Standard and international Standards Commisioning of 3x365 MVA 380/13.8 kV Power Transformers. Progress Reporting of 10 MVAr 34,5 kV Shunt Reactor. Supervision of Safety & System Grounding & Laying of Earthing Mesh.Supervision of Auxiliary Power Transformers & AC / DC Auxiliary Supply Distribution system. Supervision of cable laying Control, Instrumentation, Metering, Auxiliary Power, Communication. Supervision of Normal & Emergency Lighting system & Testing of illumination level. Progress Reporting & schedule implementation. Planning, scheduling, monitoring and the supervision of HV, MV Projects .

400 kV 154 kV AIS & GIS Switchyard

Desing requirement has been performed for double main bus bar plus transfer, double main bus bar, main bus bar and transfer configurations like primary equipment selection, earthing design by Cyme Grid Software, relay coordination of distance differential, overcurrent and earth protection has been performed. Fire protection system has been evaluated such as hydrant, hybrid or $C0_2$ for control, communication and battery rooms, CAF for large scale transformers, water spring for cable galeries, etc.. Supervision of installationhas been performed numerous plants. 100 number of AIS and 4 number of GIS plant has been supervised.

Cogeneration & Lanfil/waste Biogas, Waste Heat Power Plant

Feasibility studies can perform related to heat and electric consumption .Supervision installation gas engine and generator group with auxiliary system. Perform adjustment of AVR GVR and generator set values.
Biogas PP feasibility studies can perform regarding waste management system, besides performing all electrical calculations.

Comventional PP(CCHP)

Responsible for the check out installation test documents, commisioning and grid impact test peredudure of the gas and steam turbine and auxiliary equipment in a first, second and third class power plant. Some of the equipment at the FGD, DeNOx, EF, import or local coal based Boiler(Fluidizedbed, Super critical pulvarized), BOP, Switchyard and so on. I have been also auditing progress of conventional farm during installation, commissioning, SAT procedures includes **Primary Frequency, Secondary Frequency and Reactive Power Control Real Site Test** up to 700MW/unit, in.

Geothermal PP

Responsible for the check out installation test documents, commisioning and grid impact test peredudure of the gas and steam turbine and auxiliary equipment in a first, second and third class power plant. Some of the equipment at the BOP turbine-generator, boiler, transformer, cubicles(LV, MV) and so on. I have been also auditing progress of geothermal farm during installation, commissioning, SAT procedures

Wind PP

Designing the lay out of the network dealing with all the related details and technical aspects that affect the design process, this includes for example planning the needed material (Cables, Joints, Terminations, CBs and RMUs, ..etc.) and excavations to provide reliable electrical energy distribution to current and newly planed areas.Responsible for the check out installation test documents, commisioning and grid impact test percedure of the wind turbine power plant comply with IEC 61400-21.Performing analysis of cable and grid code requirements. I have been also auditing progress of wind farm during installation, commissioning, SAT procedures.

Solar PV PP

I have been performing PV power plant design calculations comply with IEC 60439, IEC 62446, IEC 60364 such as short circuit, selectivity, conductors transformer CB seizing, MPPT calculations for invertor and shadow effect analysis with PVsyst. PV power plant audit with regard to all aspect of installation.

I have been also auditing progress of pv farm during installation, commissioning, SAT procedures.

WORK EXPERIENCE

KTBK / CORPS ENGINEER

Cyprus Turkish Peace Forces Command Girne/Cyprus
P:+392 815 35 00
(August 2008/ July 2009)

The duty is maintenance, operation and data acquisition of electrical system of building and facilities in Cyprus as an electrical officer. Additionally, bidding procedures, preparing technical terms and condition documents electrical equipment purchasement formalities, and management of relation with distribution and transmission system operator Cyprus Electricity Autohority KIBTEK.. All projects desing, calculation, and imlementation criteria, referanced by IEC and British Standarts(BS) in particular.

Project approval procedures is carried out for new buildings and facilities of troops.

Controlling of contructions

EDUCATION AND TRAINING

University Education Master &Science

Graduate Education

2008-2010 Istanbul Technical University **(ITU**) /Turkey

Institution of Energy

"Grid Integration of Conventional and Renewables PP" (Postponed at Thesis Phase)

2002-2007 Istanbul Technical University **(ITU**) /Turkey

Undergraduate Education

Electrical and Electronic Faculty

Electrical Engineering

Electrical and Electronic Faculty, Electrical Engineering; As a Member of fully integrated **ABET** (Accreditation Board for Engineering and Technology, Inc) Accreditation Criteria in US.

- ABET, incorporated as the Accreditation Board for Engineering and Technology, Inc., is a non-governmental organization that accredits. The accreditation of these programs occurs mainly in the United States but also internationally.. The accreditation of these programs occurs mainly in the United States but also internationally. ABET has been estanblished in 1932 and recognized by the CHEA.
- Mainly, ASME, IEEE, ASTM, ASCE, ASSE, ASEE, ANS,NSPE, TMS, SPE, SFPE societies are full member societies who own and operate the organization, and many other international communities.

ASCE – American Society of Civil Engineers; ASEE – American Society for Engineering Education; ASME – American Society of Mechanical Engineers; ASSE – American Society of Safety Engineers; IEEE – officially still the *Institute of Electrical and Electronics Engineers;* IIE – Institute of Industrial Engineers; INCOSE – International Council on Systems Engineering; ISA – formerly the Instrument Society of America, now International Society of Automation; NCEES – National Council of Examiners for Engineering and Surveying; NSPE – National Society of Professional Engineers; SAE International – formerly called the *Society of Automotive Engineers;* SFPE – Society of Fire Protection Engineers; SME – Society of Manufacturing Engineers; SME-AIME – Society for Mining, Metallurgy, and Exploration, Inc.; SNAME – Society of Naval Architects and Marine Engineers; SPE – Society of Petroleum Engineers; TMS – The Minerals, Metals & Materials Society

HighSchool Education

1999- 2002 Eskişehir Anatolian High School / Turkey

61.YIL

Trainning, Workshop Official Activities

- **October 2015 Nordex Grid Compliance Inspection Hamburg/Germany (Site Acceptance Test)**

Type Test Certificate: Grid integration of Wind Turbine comply with "grid code" test percudure according to IEC 61400.

Grid impact and connection study,

Low /High Voltage Ride Through (LVRT-HVRT) Analysis, Active Power Control, Frequency Response Analysis, Reactive Power Support site inspections for grid connected sample test bench.

- **April 2015 GE&JENBACHER Gas/Fuel oil/LNG/Biogas Engine Test Percudure Verification Austria**

All the inspection was made by participation of Professor who are from Istanbul Technical Univerrsity electrical and mechanical engineering department. The test-bench is convenient according to **ISO 3046, ISO 8528 IEC 60034 IEC 60364.** Engine-generator routine test accrediation requirements verified in terms of electrical and mechanical durability for each type of engine as follow; J208 J312 J316J320 ve J416 J420 J412 ve J612 J616 J620 J624 ile J920 J924

- **November 2014 RES4MED Grid Integration of Reneawables Milano Italy (30 days)**

International Training course was held by **University of Politechnico Di Milano**. Grid integration of renewables regarding biogas, pv, wind, and CSP technologies. Manufacturing ,desing and feasbility studies of those power plant equipment ; GRID CODE analysis DigSILENT .Those simulation studies performed for Wind Power plant and PV power plant accroding to Turkish Grid Code. Only one of the PV power plant has been studied according to griid code in **Gambia**

- **June 2014 Brussel energy effecinecy issues based on EU Commision and TUrkey**

EU Commission Energy efficcieny studies and possible coordination with EU. Cogeneration applications and possible business cooperation for further development energy sector cooperation between EU and Turkey.

- **Kopenhagen - DENMARK (9 days)**

April 2013 EWEA 2013 Wind energy Fair and Exhibition center and Conferances

- Presentation on new ooportunities in the Turkish energy sector
- New energy Technologies and iniative development in sector.

April 2012 EWEA 2012 Wind energy Fair and Exhibition center and Conferances

- Presentation on new ooportunities in the Turkish energy sector
- New energy Technologies and iniative development in sector.

- **March 2011 "*OECD IEA "*Nuclear Energy Agency (NEA) Workshop.**
  - 23-25 March 2011, Paris, "*The Committee on Nuclear Regulatory Activites (CNRA) /Working Group on the Regulation of New Reactors (WGRNR)*"
  - 30 March – 1 April 2011, Paris, "*The Committee on the Safety of Nuclear Installation/Working Group on Risk Assessment (WGRISK)*"
  - 4-5 April 2011, Paris, "*The Committee on the Safety of Nuclear Installation/WGIAGE Sub-Group on the Seismic Behaviour of Components and Structures*"
  - 6-7 April 2011, Paris, "*The Committee on the Safety of Nuclear Installation/WGIAGE Sub-Group on the Ageing of Concrete Structures*"

Paris / France (15 days)

- **May 2010 "*OECD IEA Standing Group On Long Term Co-operation (SLT)* Workshop *Turkish Energy Policy Report*"** Paris / France (5 days)

April 2010 *Solar Energy System – PV and CSP Feasibility and Design*

PV -- Modelling and Optimization Software Programing SAM; PVsyst. By the USA NTEL(National Energy Tech. Laboratory) Academicians EIE / Ankara (15 days)

April 2010 *"6th European Business and Investment Forum"*

"East-West Summit on Energy and Sustainability" Vienna/Austria(5days)

April 2010 *Job Security for Medium-High Voltage System /Majesty Mirage Park Hotel* Göynük-Antalya (6 Days)

April 2010 *Modelling of the Hydroelectric Turbine vibration and solving its possible problems by using CFD Analize that prevent feasible productivity of HEPP /*Rixos Hotel Ankara

February 2010 *European_Comission_JRC_Institute of Energy_Zagreb_Crotia "Energy Challenges Using Non Fossil Fuel Technologies" . My presentation is about; Renewable Energy Sources Deployment and Energy sector analysis in Turkey.* – Crotia / Zagreb-(4 Days)

February 2010 Wind Energy and grid issue, Technological affair-Ankara

January 2010 Strategic Thinking Center /Energy management and its Technologies.

December 2009 Solar Energy Turkey, Istanbul, December 2009 (2 Days)

October 2009 EIE Energy Efficiency and Applications /Ankara (1day)

December 2008 North Cyprus Peace Forces (NCPF--KTBK K.lığı) Information System Conference_Cyprus

April 2008 A++ Colsultations ISO 9001 Certificate Program

Dec- Feb 2006 2007 TMMOB\ EMO Energy Management \ SCADA&PLC Measuring Verifying

November 2006 Fatih Toefl Training (1 month)

November January 2004 Istanbul Technical University Deutsch Training (Gothe Courses) (3 month)

PERSONAL SKILLS

Mother tongue(s) Turkish

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C1	C1	C1
	IELTS **ITU Proficiency Exam** Grade: 70/100 YDS(FLE): 67/100				
Arabic	A1	A1			A1
Spanish/Deutsch		A1			A1

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2 Proficient user
Common European Framework of Reference for Languages

Communication skills

- Open minded
- Friendly English and Turkish Good Communication in both language

Organisational / managerial skills

- I have been significant experience in audit&supervision as a team leader for 7 years. I have worked in lead role on mega conventional and renewable power plant project (CAPEX > 1 bln $US) .
- Energy Power plant investment management (8 years)
- Transmission and Distrubution investment process management (6 years)
- Electrical Facility Project Construction Management (2,5 years)
- TMMOB Chamber of Electrical Engineer High Voltage System and Autocad 2010 Course (2006 June-August)
- ***Competencies:*** Renewable Energy; Power engineering; Energy Policy, Strategy and Institutions; Power sector Planning; Integrated /coordinated planning; Integrative Skills; **Policy Dialogue Skills; Economic and Financial Analysis of Energy Projects.** High talent for carriying out all related procedures for PV, WPP, Biogas power plant investment from site preparation to commisioning.

Job-related skills

- Medium level experience implementation for the standarts EN ISO 17021, EN ISO 17025, EN ISO 17065, EN ISO 27001.
- High level Experience apply for **EN ISO 17020,** EN ISO 50001:2011 EN ISO 9001:2015, EN ISO 14001, and relevant management, products and site inspections test standarts.
- **IEC 60909, IEC 60364(-7,6,5 ,4), IEEE 399,**
  - Grid integration analysis by using DigSILENT Power Factory 15.1. (5 year experience),
  - ETAP 12.6.0 (9 years experience); CYMEGRID (4 years experience) simulation program.
  - Power systems / protection studies Technical Acceptance Procedure and implementation of the Power Plant Electric, DCS/SCADA/PLC and Electromechanical test procedure
- *Electrical Project analysis with software program ETAP 12.6 . has been performed;*
  - Load flow,
  - IEC 60909:0:2001 Short circuit study
  - IEEE399 Selectivity, IEEE242
  - IEEE 1584 Arc Flash
  - IEEE 399 Voltage Drop
  - IEEE C.37 LV Equipment Compatibility
  - Fire and arc flash NFPA-70E
  ICEA P32-382, P45-482 for conductors

- HV Cable insulation resistance and VLF HV IEC 60502(part 1-2)

IEC 60865(SC calculation effect, IEC 60331 and EN50200 Fire Protection Cables, IEC 61936 power installation1kV>, IEC 60801 Monitoring and control, IEC 62305(1,2,3,4), IEC 62643, IEC 61662 earthing&lightning, BS EN 60529 Degree of protection classes, EN 54 Fire detection, EN 60536 Class. Elec. Shock., IEC 61921 power factor, BS EN 62305 Risk assesment. Switchgear IEC 62271, Relay Current Injection Test IEC 60255-1, CT tests (burden, ratio, polarity) IEC 60044-6

- Responsible for project approval and acceptance procedure of Wind PP ,GeoPP, BioPP, ThPP, CCHP CHP, HEPP and. I've approximetly participated 2000 MW installed wind, 800 MW Cogeneration PP, 80 MW Biogas PP, 150 MW Geothermal PP, 6000 MW Conventional Thermal power plant acceptance and take over procedure.

  - I have been working for power and oil&gas industry for more than 10 years.I have primarily worked on renewables and converntional power plants high voltage substation, and oil&gas fields related to approve EPC bidding/vendors' documents..My main role have been supervise and commissioning.
  - To be designed HV substations according **NFPA some EU norms, UL and FM codes**, lead fire protection not limited to ***Compressed Air Foam(CAF), Hybrid(Ni-Water) Protection System*** and interlinked smart fire control system have been studied for the contractors, held on TEIAS, grid operator, bidding procedures. 16 number of 400-154kV substations have been studied to implement these solutions such as project drawings, tendering procedures and simulation compiling. Thus, risk management report shave been published for the client contractors.

Software, Equipment Test Skills, Engineering Programs, Digital competence

SELF-ASSESSMENT				
Information processing	Communication	Content creation	Safety	Problem solving
Microsoft OS/ Office Tools	proficient	proficient	proficient	proficient

C/C++	-	independent	Independent	Independent
Relay Test (MICOM)	proficient	independent	Independent	proficient
Grounding Pr. Test (SELV)	proficient	proficient	Independent	proficient
Isolation Test (CT, VT, Generator.,Transf. Cable)	proficient	proficient	Independent	proficient
Thermo Flow	proficient	independent	-	Beginner
WindPro	proficient	independent	-	Beginner
PVsys	proficient	independent	-	Independent
PLC Programming	Proficient	Beginner	Independent	Beginner
ETAP (load flow, reliability, relay coordination, earth protection touch and step voltge analysis, arc flash etc.)	proficient	proficient	Proficient	Proficient
DigSILENT	proficient	independent	Independent	Independent
Cyme Grid	proficient	independent	Independent	Independent
PLS CADD 6.0 Tower	proficient	independent	Independent	Independent
BIM Building Information Management	Proficient	Beginner	Independent	Beginner

Levels: Basic user - Independent user - Proficient user
Digital competences - Self-assessment grid

Driving licence: Driving licence category/-ies. Class B

ADDITIONAL INFORMATION

Publications

Some Essays

- Wind Farm Dynamic Analysis in terms of Turkish Grid Codes *[IEEE Power Engineers PMAPS 2016 Conference, Oct. 16 - 20, 2016, Beijing, China]*
- Building Primary Equipment for Wind Power Plant *[Sriwijaya International Conference On Engineering, Science And Technology, Bangka Island, Indonesia, November 9-10, 2016]_awaited for published.*
- Electrical Vehicle To Grid Integration And Dynamic Response Capability *[England Birmingham] Postphoned*
- Dynamic Requirement and Analysis of Photovoltaic Power Plant Comply With Draft Turkish Grid Code *[Austria_Vienna_Solar wind integration workshop 14-18 Nov 2016]*

▪ Basra **US Navy** Electrical Facility **Study on behalf of NY JACOB ENGINEERING Co.** Newyork/USA

Some International Projects

Project include 11kV and 15 kV grid system, 15 MW CCHP Power Plant which includes 8 Caterpillar engine generator group (GENSET), and 24 step down transfomer. OHL(overhead lines) and cables are approximetly 15km length. The facility has been performed with software ETAP 12.6 .
As for IRAQ Bagdad project - Load flow, - IEC 60909 Short circuit study - IEEE399 SElectivity, IEEE242 - IEEE ARc Flash - IEEE 399 Voltage Drop - IEEE C.37 LV Equipment Compatibility studies are performed and confirmed by NY JACOB ENGINEERING.

- **Private School and Shopping Facility, performing simulation by ETAP on behalf of NY JACOB ENGINEERING Co.** Newyork/USA
  Project, include, 11kV utility system, 1,2 MVA installed capacity transformer and emergency diesel generator group, has been performed with software ETAP 12.6 .
  Following study has been performed; Load flow, - IEC 60909 Short circuit study - IEEE399 Selectivity, IEEE242 - IEEE ARc Flash - IEEE 399 Voltage Drop - IEEE C.37 LV Equipment Compatibility studies are performed and confirmed by the Client.

- **Grid impact studies Lebanon 5MWp solar PV Project in Beyrut/Lebanon**
  Grid Impact Assessment and 20kV Grid Connection Study for a [(3x14x50kWe+2x16x50kWe)]5 MWp PV system to be connected to the grid.
  - Grid impact and connection study, includes; Dynamic Model of PV and Inverter and Main Controller, Transformer, Power Plant Point of Common Coupling (PCC), Subsation OHL connection, Load Flow Study, Short Circuit Study (IEC 60909), Selectivity of LV CB (LG-LLL) and MV CB (Relay Coordination, IEEE 242), Power Quality Study, Harmonic Disturbance, Flicker, PV (Type), LVRT, Compliance Level, Active Power Control Compliance, Frequency Response Compliance, Reactive Power Capacity Compliance.

- ***Capacity Building on Dynamic Model Applications Power Plant [EU_SEI Projects_Accepted]***
  To increase the share of renewable energy in installed capacity and operate the Turkey's Electricity System in a qualified, affordable, reliable and uninterrupted manner, in order to meet the growing demand. Improvement of the decision making processes within MENR and TEİAŞ regarding grid integration of renewables through increasing human resources capacity in dynamic simulation applications for wind and solar power plants. (a) dynamic modelling of coal burning boiler, steam and gas turbine / engine (GVR etc.) and an existing generator (AVR PSS etc.) which is developed after 2009 and, (b) dynamic modelling of an existing wind turbine generator group (Type C / Type D) DFIG (Doubly Fed Induction Generator), FSIG (Full Scale Induction Generator), or FSSG type turbines include convertor and master main controller dynamic models which has to be built after 2013; photovoltaics panel and invertor as well.
- ***Investigation of Renewables effect for power system [Project, Accepted]***

Some National Projects

This work is devoted to the modeling of grid compliance studies and investigation of fault ride trough capability of the pv and wind turbines. In the thesis, requirements of grid codes for pv and wind power grid integration compliance studies which used dynamic mathmatical models, provide grid requirements. These simulation outputs is almost matched comparing with exact values. Investigation of the influences on the grid and raising connected capacity of wind and pv is the main focus of this thesis. Models of grid-connected wind, gas turbine and pv are implemented in the region Trakya by using system values, when minimum load conditions occured in 05.10.2014. With these dynamic models and computer simulations, influences on the grid during the faults are discussed. Morever, system dynamic response has been studied and monitored in acceptable level, regarding system stability.

I have been auditing procedures of Distribution company Çamlıbel(ÇEDAŞ), as an energy expert, on behalf of BBS Certified Co. regarding to ISO 14001, ISO 10002

Military Obligation

Already done **in CYPRUS as an Electr. Officer**. There is no military obligation (2008-2009). The duty was maintenance, operation and data acquisition of electrical system in Cyprus. Additionally, bidding procedures, preparing technical terms and condition documents electrical equipment purchasement formalities, and management of relation with distribution and transmission system operator Cyprus Electricity Autohority KIBTEK.. All projects desing, calculation, and imlementation criteria, referanced by IEC and British Standarts(BS) in particular.

Certifications

- **Politechnico Di Milano** and RES4MED “Grid Integration of Renewables” (1 Month)_2014 Milano/ ITALY
- **EU Norms & Legislation** related to energy sector.2016 (6 days) Brussel/Belgium
- **Econometry** and Time Series Anslysis TOBB ETÜ University (4 Month) 2015 Ankara/Turkey
- **EU CARF: Center for Advanced Research in Finance PPPCoE** Boshporus University_2016 (5 days) Istanbul/Turkey
- TS **EN ISO 9001:2015** Quality Management System (Auditor and Lead Auditor &Consultancy Certified by **CQI IRCA Approved: UDN: 1312, Course Number 18207**), 2017 Ankara/Turkey

- TS **EN ISO 18001:2014** Quality Management System (Auditor and Lead Auditor &Consultancy Certified by **CQI IRCA Approved: UDN: 1312, Course Number 18207**), 2017 Ankara/Turkey
- TS **EN ISO 14001:2014** Quality Management System (Auditor and Lead Auditor &Consultancy Certified by **CQI IRCA Approved: UDN: 1312, Course Number 18207**), 2017 Ankara/Turkey
- TS EN **ISO 50001:2011** Energy Management System (EnMS) (Auditor and Lead Auditor &Consultancy Certified by **CQI IRCA Approved: UDN: 1312, Course Number 1614**): 2017 Ankara/Turkey

Electric Officer/Electro-Technical Officer Shipping Man ID card has been taken as an electrical engineer for the **offshore projects and marine industry.** I have been certified as electrical officer for ship according to **IMO_SOLAS** by **Ministry of Transport, Marine and Communication.** I have an junior experience marine industry as being surveyor and inspector in terms of engine-generator and relevant electrical system. My **seaman ID card** is define for electrical-electrotechnical officer/engineer for the offshore renewables oil&gas platform projects. I have obtained following certificate;

- **Based SCWT Certificate,**
- **Tank/Chemical Certificate,**
- **High Voltage Design/Operation,**
- **Fire Protection And Fighting Certificate**
- **LNG_Liquid Gas Certificate**

ANNEXES

Annex 1- Details for work experiences
Annex 2- Details for National and International Papers
Annex 3- Details for Certificates

ANNEX 1 ■ *Some of the Technical Duties and Experiences Related Electrical&Power&Oil&Gas Industry*

I've approximetly participated 2000 MW installed wind, 800 MW Cogeneration PP, 80 MW Biogas PP, 150 MW Geothermal PP, 8000 MW Conventional Thermal power plant acceptance and take over procedures in which turkey's total installed capacity is about 80860 MW.
I have been power generation, transmission and distribution sector and having powerful experiences related to those points for 10 years.

- Transmission sector : numbers of 154kV-400kV Over Head Line Project Application approved. Most of those OHL projects were supplied grid connection of power plants which were connected through transmission level. Besides OHL project I have been lots of 154kV and 400kV Substation project approved procedures.
- Distribution sector : numbers of 36kV Over Head Line Project Application approved. Most of those OHL projects were supplied grid connection of power plants which were connected through transmission level.
- Related to power generation such as;

Hydro Power Plant

- Alkumru HEPP _ 280 MW Francis Type Turbine _Siirt
- Kulp HPP_ I _ 22 MW _Francis Type Turbine_Diyarbakır
- Kalkandere HPP_ 36 MW_ Francis Type Turbine_and 50 MVA Power Transformer İkizdere/Rize
- Uzundere HPP_63 MW_Pelton Type Turbine 80 MVA Power Transformer _Trabzon
- Murgul HPP_24 MW_ Francis Type Turbine_Artvin

Many others…

Wind Power Plant

- GAMA WPP _ 22,5 MW_40 MVA Power Transformer
- Soma WPP _ 144 MW_160 MVA Power Transformer
- Gökçedağ WPP _ 135 MW_150 MVA Power Transformer
- Çanakkale_Mahmudiye_ WPP _ 30 MW_50 MVA Power Transformer

Many others…

Goethermal Power Plant

- **G**ürMAT GPP_ 24 MW
- Pamukören GPP_24MW
- Tosunlar GPP_6MW
- İrem GPP_24 MW

A few others…

BioGAS Power Plant

- CEV (Gaziantep Landfill gas) Biogas PP_ 1,2 MW
- ITC-KA Adana Waste Landfill biogas PP _ 16 MW
- ITC-KA Ankara Sincan Gasification of Organic Material _ORC Pentane Turbine 5 MWe Biogas PP _ 5MWe
- ITC-KA Ankara Mamak Waste Landfill biogas PP _ 16 MW
- ITC-KA Ankara Sincan Waste Landfill biogas PP _ 16 MW
- HER Energy Kayseri Waste Landfill biogas PP _ 2 MW
- Bandırma Chicken waste gasification system Biogas PP 2 MW
- Suluova Biogass(%70 Chicken; %30 Cow waste)PP_1MW_Amasya
- SÜTAŞ Enfaş 2MW Biogas(%70 Cow waste %20 Organic Slash Waste, %10 Farmer waste material) PP Aksaray
- SÜTAŞ Enfaş 2MW Biogas(%70 Cow waste %20 Organic Slash Waste, %10 Farmer waste material) PP Balıkesir

Many others…

Coal based Thermal Power Plant

- ZONGULDAK EREN Energy import Coal PP _ 1x700MW_Supercritical Pulvirized boiler 1x800MVA Power Transformer and 400kV Substation;
  Import Coal Harbour Projects are in the scope power plant acceptance procedure.The harbour facility has been auited according with oceanography rules and enviromental requirements. Thus, sea water temperature and sea water intake and outage terminal have been supervised.

- ATLAS Energy import Coal PP 1x600 MW_Supercritical Pulvirized boiler 1x700MVA Power Transformer and 400kV GIS Substation
- Adularya Energy PP _ 2x150MW _ local lignite coal _Fluidizedbed boiler 1x180MVA Power Transformer and 400kV Substation
- İÇDAŞ Energy import Coal PP 1x600MW_Supercritical Pulvirized boiler, 1x700MVA Power Transformer and 400kV Substation
- Çumra Sugar Energy PP _ 1x40MW _ local lignite coal _Fluidizedbed boiler

A few others…

CCHP/Combined Cycle Heat Power PLant

- RWE Denizli CCHP PP 870 MW
- Yeni Gebze CCHP& Suez 870 MW İzmit/Gebze
- EnerjiSA_Bandırma CCHP_ 930 MW
- Uğur Energy CCHP _ 49 MW
- Kırklareli Alarko_ Altek CCHP _ 20 MW
- Samsun Cengiz Energy CCHP_ 100 MW
- Can Enerji 50 MW CHPP Tekirdağ
- ODAŞ Energy 50 MW CCHPP Urfa

A few others…

CO-GENERATION Power Plant and auxiliary system Audit Experiences as a Sample (Some of Them)

Hotel
- Makyol Etiler 0,6 MW Cogeneration PP engine and generator group_İstanbul
- The Grand Tarabya Hotel 2 MW trigeneration gas engine and generator group_Bayraktarlar Group_İstanbul

Shopping Center
- Fener Energy, Meysu Outlet Shopping Center 1,2 MW_kayseri

Hospital
- Lokman Hekim Hospital 0,5MW Trigeneration PP_Ankara
- Emsey Hospital 2 MW Cogeneration PP_İstanbul

Airport and Aviation Industry
- Antalya ICF Airport Tri-generation PP _ 12 MW
- Esenboğa Airport Trigeneration PP_ 6MW

Cement Industry
- Akçansa Cimento 15 MW (first Waste Heat Power Generation power plant in Turkey) built by Chinese Company
- Batıçim Cimento 9 MW WHPG Coal Based Fluidized bed Boiler and Steam Turbine-generator group
- Bursa Cimento 10 MW WHPG(Commisioning has been stopped) Coal Based Fluidized bed Boiler and Steam Turbine-generator group

Plaster Industry
- Knauf Plaster 1,2 MW Cogeneration Power plant, steam and hot water process in the industry [Egsozst of gas engine is directly feding plaster furnance requirement of the facility and this half of this requirement meets from at this generation. Furthermore intercooler and jacket heat could take wtih HT exchanger. This hot water can utilize in the process of the industry.Ankara
- LAFARGE Plaster 1,2 MW Cogeneration Power plant, steam and hot water process in the industry [Egsozst of gas engine is directly feeding plaster furnance of the facility which has met half of the full requirement. Furthermore intercooler and jacket heat could take with HT exchanger. This hot water can utilize in the process of the industry. İzmit

Plastic Industry
- Naksan Plastic 12 MW Cogeneration Power plant, steam and hot water process in the industry [Each gas engine generator group is 3 MW capacity, CATpillar and LoreySomer brand, there is WHPG steam boiler at Egsozst of gas engine and steam requirement of the facility meets. Furthermore intercooler and jacket heat could take wtih HT exchanger. This hot water can utilize in the process of the industry.

Oil&gas Petrochemical Industry
- TÜPRAŞ Cogeneration PP _ 12 MW Back Pressure Steam Turbine Generator group which is fed by natural gas based.boiler, Kırıkkale

Chemical Industry
- Alkim Chemistry 5 MW Gas Turbine generator group and its auxliary system_İzmir

Iron & Steel & Alimunyum Industry
- Kardemir Iron Steel Industry 15 MW back pressure steam turbine(local coal based)
- ASAS Al. Industry Co.6 MW Trigeneration gas engine generator group PP._Sakarya

Sugar Industry

- Burdur Sugar Factory 4MW back pressure steam turbine and boiler(natural gas baesd)
- Konya_Çumra Sugar Factory 12 MW back pressure steam turbine(siemens) and boiler(local coal based)

Food Industry
- AK Gıda Co. 7 MW Natural Gas Based Cogeneration Unit Gas Turbine Generator Group_Sakarya
- Meysu Gıda Nevşehir 1 MW Cogeneration Unit, Local Coal Based Fluidized bed Boiler and Back Pressure Steam Turbine-generator group
- İttifak Holding, Selva Gıda Konya 1,4 MW Cogeneration Unit, Natural Gas based gas engine and generator group

Textile Industry
- Bursa RB_Karesi Textile Cogeneration PP _ 8 MW
- Gülle TExtile Industry Cogenertion PP_12 MW
- Derhan Textile Industry, 1,2 MW Cogeneration Unit, Natural Gas based gas engine and generator group_Bursa
- Teksmak Machinery and Textile Industry, 1,2 MW Cogeneration Unit, Natural Gas based gas engine and generator group

Forestry&Wood&Agriculture
- Kastamonu Entegre 5 MW Cogeneration PP Turbomach Gas Turbine generator group and waste heat boiler _izmit

ANNEX 2

IEEE Power Engineers PMAPS 2016 Conference, Oct. 16 - 20, 2016, Beijing, China_Accepted Paper

Wind Farm Dynamic Analysis in terms of Turkish Grid Codes

Abstract— **Wind power plant installations continue to increase worldwide because it is a kind of renewable and harmful emissions-free energy source. The increased capacity of wind power needs the new strict requirements related to the grid connections of wind generators. The requirements defined in the grid codes can be states as reactive power control, fault ride-through (FRT) capability of the wind turbines, active power and frequency control. The grid codes affect inevitably the developments of wind turbine technology. Today wind power plants are expected to support the grid and provide ancillary services much like conventional power plants. This paper presents a simulation based monitoring approach for the dynamic behavior of a wind farm with doubly fed induction generators (DFIG). Simulations are performed to check how Turkish grid codes complies with the dynamic effects of the wind turbines on the power grid as a reflection of disturbances. The response of wind turbines at the point of common coupling (PCC) are analyzed. Simulation studies are conducted using the power system simulation tool DIgSILENT Power Factory. From this analyses, it can be concluded that Turkish grid codes need to be detailed and expanded to maximize the capacity of wind power plants keeping stability constant in Turkish power system.**

Index Terms– **Wind power plant, monitoring, Turkish grid codes, ENTSO-e, dynamic modelling, doubly fed Induction Generator DFIG, simulation,**

I. INTRODUCTION

Nowadays, wind power plants (WPP) integration to the grid follows an increasing trend which results in large amounts wind power injection due to growing interest to clean, renewable, and cheaper energy worldwide. This large scale penetration of wind power to the grid generates new serious problems in the secure operation of the power system because of intermittent and fluctuating behavior of wind speed. At the same time wind power has inherently stochastic nature, therefore, the wind speed and wind power prediction become uncertain. This fact forces many countries to adopt and revise grid operating codes for wind farms specifying the fault condition under which a wind turbine generator (WTG) should remain connected to the grid [1], [2]. The grid codes are technical interconnection requirements for the wind power plants to the grid, which mainly involve analyzing of the operational dynamic behavior of WPP. Therefore, it can be say that the desired behavior is defined by the applicable grid code. Essentially, such network code influences the controller design and selection of the parameter settings with multiple tasks similar controls to those of conventional power plants. One of these control tasks is the fault ride-through capability of the wind turbines [3].

There are plenty of studies assessing the grid integration of the WPP in terms of economic and technical point of views. Reference [4] states that the reliable and effective grid is able to facilitate by just only supported with grid code requirements. Moreover, as stated in [5], the grid integration of the large scale wind power plant can give rise to stability concerns and dramatic voltage fluctuations in addition to provide countless benefits. This fact can be realized in comparison of the grid codes of some countries such as Germany, Switzerland, Denmark, Ireland, and UK. For this purpose, some storage systems have been carried out optimization with renewables. Small and large scale wind farms involving low wind penetration up to %5, has investigated in [6] in terms of dynamic effect on transmission system, power quality, operational cost and power unbalance.

Different simulation programs are being used to analyze the mutual interaction between electric power system and WF. DIgSILENT/Power Factory, PSS/E, PSCAD/EMTDC, and MATLAB/Simulink, can be named as the most common simulation programs for these analyses [7 -11]. The dynamic behaviors of DFIG and Fixed Speed Induction Generator (FSIG) against to the various types grid failures are examined in [12] - [16]. Reference [17] represents the voltage and rotor angle instability for bilateral working of WPP and PV. Reference [18] states that, if the integration of power which is produced by renewable sources, is in low rate *(5% or a little more 5%)* in general, the effects of PV and WPP on the grid becomes little in specific, otherwise, the effects become undoubtedly higher, but acceptable level.

The aim of this research paper is to present a study of the dynamic effects of the wind farm having variable speed DFIG on the power system, and to check the fault ride-through capability of DFIG wind turbines. Different case studies are carried out in order to enhance the understanding of the grid

IEEE Power Engineers PMAPS 2016 Conference, Oct. 16 - 20, 2016, Beijing, China_Accepted Paper

fault impact on the power system itself.

II. MODELLING OF DFIG WIND TURBINE

Three main types of electromechanical conversion system currently used in wind turbines in most application; constant speed units such as FSIG, and variable speed units such as DFIG, and full converter synchronous generator (FCSG). There are some important advantages of DFIG that explain why DFIGs are adopted extensively in wind turbines; these are operational capability in variable speed, low operating noise, mechanical stress mitigation, control flexibility for active and reactive power, and the fault ride-through (FRT) capability for wind farms connected to the grid [19-21].

The configuration of variable speed wind turbine with DFIG with overall control system is shown in Fig. 1. The wind turbine is connected to the DFIG through a mechanical shaft system. The stator is connected to the grid directly, whereas the rotor is connected to the grid via partial scale back-to-back power converters. A two-level IGBT voltage source converter (VSC) system, namely, a rotor side converter (RSC) and a grid side converter (GSC), connected back-to-back by a dc-link capacitor. The crow-bar circuit is used to short-circuit the RSC to protect it from over-current in the rotor circuit during transient disturbances. The rotor is fed through a variable frequency dc-link-voltage converter, which only needs to handle a fraction (25-30%) of the total power to achieve the full control of the generator [22]. The rotor-side converter (RSC) controls the torque or active/reactive power of the generator while the grid-side converter (GSC) controls the DC-link voltage and its AC-side reactive power [23].

The asymchronous generator model has been described by the following well-known dynamical equations in orthogonal d-, and q-synchronous reference frame as follows [14], [23]:

$$v_{ds} = R_s i_{ds} - \omega_{syn}\psi_{qs} + \frac{d\psi_{ds}}{dt} \quad (1)$$

$$v_{qs} = R_s i_{qs} + \omega_{syn}\psi_{ds} + \frac{d\psi_{qs}}{dt} \quad (2)$$

$$v_{dr} = R_r i_{dr} - (\omega_{syn} - \omega_r)\psi_{qr} + \frac{d\psi_{dr}}{dt} \quad (3)$$

$$v_{qr} = R_r i_{qr} + (\omega_{syn} - \omega_r)\psi_{dr} + \frac{d\psi_{qr}}{dt} \quad (4)$$

$$P_s = \frac{3}{2}\left(v_{ds} i_{ds} + v_{qs} i_{qs}\right) \quad (5)$$

$$Q_s = \frac{3}{2}\left(v_{ds} i_{qs} - v_{qs} i_{ds}\right) \quad (6)$$

$$T_e = \psi_{ds} i_{qs} - \psi_{qs} i_{ds} \quad (7)$$

where v_{ds}, v_{qs} , v_{dr}, v_{qr}, i_{ds}, i_{qs} , i_{dr}, i_{qr}, ψ_{ds}, ψ_{qs}, ψ_{dr}, ψ_{qr}, are voltages (V), currents (A) and flux linkages (Wb) of the stator and rotor in d- and q-axis, R_s is the resistance of the stator windings, T_e is the electrical torque and ω_{syn} is the synchronous speed, while ω_r is the angular speed of the rotor. P_s and Q_s are the real and reactive power in the stator windings respectively.

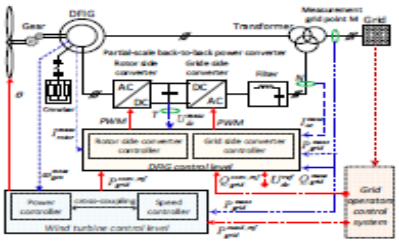

Figure 1. Overall control system of variable speed wind turbine with DFIG

For the analysis of the wind turbine's behavior during grid faults, electromagnetic transient simulations of instantaneous values are used. The generator inertia is modeled inside the built-in induction machine model. The generator inertia is specified in the form of an acceleration time constant in the induction generator type. The dynamic model of the induction generator is completed by the mechanical equation [14]:

$$J_g \cdot \frac{d\omega_r}{dt} = T_e - T_m \quad (8)$$

where J_g is generator inertia, T_m is the mechanical torque.

$$T_n = \frac{P_n}{\omega_n(1 - s_n)} \quad (9)$$

The acceleration time constant t_{ag} can be expressed as:

$$t_{ag} = \frac{J_g(1 - s_n)\omega_n^2}{P_n} \quad (10)$$

where P_n is the nominal generator power output, ω_n is the nominal electrical frequency of the network and s_n is the nominal slip ($s_n = (\omega_{syn} - \omega_n)/\omega_{syn}$).

On the other hand, DFIG model in DIgSILENT, illustrated in Fig. 2, extends the usual induction generator by a PWM rotor side converter in series to the rotor impedance Z_{rot} (DIgSILENT GmbH, 2002) [14, 15]. The PWM converter inserted in the rotor circuit allows for a flexible and fast control of the machine by modifying the magnitude and phase angle of the generator's AC voltage output U_{AC} on the rotor side.

ANNEX 3


TTMİSTANBUL
Certificate of Achievement
Mustafa DEMİROL
ISO 50001:2011
Energy Management System (EnMS)
Auditor / Lead Auditor Training Course
TTMİSTANBUL


RES4MED
Certificate of Training
Mustafa Demirol
"Integration of renewable energy solutions in the Mediterranean electricity markets"
17-28 November, 2014, Milan, Italy


TTMİSTANBUL
Certificate of Achievement
Mustafa DEMİROL
has successfully completed the
ISO 9001:2015
Quality Management System (QMS)
Auditor / Lead Auditor Training Course
By passing the written examination and continuous assessment
CQI IRCA
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KATILIM BELGESİ
Sayın : Mustafa DEMİROL
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