MICHAEL W. UNGER, PE
Principal Electrical Engineer

EDUCATION	Master of Science, Electrical Engineering, Stanford University Bachelor of Science, Engineering Science, University of Portland
PROFESSIONAL REGISTRATION(S)	CA #11239; OR #6801; WA #32554
ORGANIZATIONS	Member, Institute of Electrical & Electronic Engineers Past President, American Council of Engineering Companies of Oregon
KEY SKILLS	Load Studies Transmission and Distribution System Studies Loss Analysis Generation Interconnection Studies
TOTAL EXPERIENCE	35 years

Michael W. Unger is an experienced electrical engineer who has focused his career on system planning studies of primary electrical systems, He has over 25 years of experience acting as project manager of system planning studies, and Mr. Unger's engineering experience is summarized below:

Load Studies
Identified and located existing loads as part of Long Range planning studies, Forecasted and analyzed future loads using econometric forecasts, end-use analysis, and small area load forecasts.

τTransmission and Distribution System Studies
Completed numerous studies for rural and urban utilities, industrial sites, ports and college campuses, Studies included power flow, voltage drop, short circuit, and reliability calculations, Analyzed existing facilities and loads, predicted future loads, and recommended changes in voltage levels, conductor sizes, substation transformer sizes, and system configurations to meet future requirements.

Loss Analysis
Analyzed losses and their costs for transmission and distribution systems, studied loss reduction potential from reconductoring, reconfiguration, transformer replacement, voltage conversion, and fixed/switched shunt capacitor application.

Generation Interconnection Studies
Completed Studies to determine optimal generation interconnection studies, Analyzed various options for interconnecting into the regional electrical grid, analyzed various options for wheeling power to the desired load center and completed analysis of curtailment possibilities related to transmission options other than firm transmission.

Specific examples of project experience include:

Eleven Hundred Acres Resort Development, Oregon
Managed and participated in the investigation of transmission, substation and distribution system service to a 14 MW development. Service reliability was a primary consideration. The transmission system study included consideration of 115 kV and 35 kV overhead and underground line extensions to the development. Substation considerations included comparison of outdoor versus metal clad switchgear and transformers with load tap changers compared to transformers with separate regulator banks. Various configurations for the distribution system were considered to allow for maximum reliability.

Portland West Side Planning Study, Portland, Oregon
Managed and participated in creation of Long Range Planning Study for development of Portland General Electric's Distribution System on the West side of Portland. Work included Predicting Loads for Low Density and High Density Growth Scenarios; Setting Planning Criteria regarding reliability, overhead vs. underground, etc.; Developing Plans of Service for Two Delivery Point Options; Estimating Costs; and Completing Report with Maps and Diagrams.

Hanford 300 Area Distribution System Planning Study for Rockwell, International of Richland, Washington
Developed Planning Criteria. Surveyed Existing Conditions and assess conditions of system. Located Existing Loads and worked with Rockwell Employees to locate future loads. Modeled Existing System for Computer Analysis. Assessed Performance of Existing System as existing and future loads area serviced. Developed explanatory plans with cost estimates including incremental cost overhead versus underground on for a part of the system. Selected preferred plan and wrote study report.

Long Range Transmission System Planning Study, Aberdeen, Washington
Managed development of a series of Long Range Transmission System Planning Studies for Grays Harbor PUD, Wenatchee, Washington. Developed Performance Guidelines (including reliability, loads and voltages). Determined existing and future distribution substation loads. Determined performance of existing system as future loads were served. Compared performance against guidelines. Developed exploratory plans to determine preferred system. Developed a proposed plan for upgrades and expansion of the District's transmission system.

Umatilla Army Depot Electrical Supply for Umatilla Electric Cooperative, Umatilla, Oregon
The Army Depot required highly reliable electrical service for the Army's project to dispose of nerve gas. Developed primary selective plan of service, a 115 – 12.47 substation with two transformers connected to two independent 115kV transmission systems. Completed Feasibility plan and Conceptual Design of Substation and Distribution system.

Edwards Air Force Base, Edwards, California
Developed Planning Criteria. Surveyed and assessed Existing Conditions. Located Existing Loads and worked with Rockwell Employees to locate future loads. Modeled Existing System for Computer Analysis. Assessed Performance of Existing System as existing and future loads area serviced. Developed explanatory plans with cost estimates (Included incremental cost of overhead versus underground for a part of the system). Selected and developed details of preferred plan.

Long Range Planning Study, Tillamook, Oregon
Completed Long Range Planning Study for Tillamook PUD, Tillamook, Oregon Work included: Analyzed and Evaluated Existing System Performance (Reliability, voltage and capacity); Set Planning Criteria; Predicted Loads; Developed Alternative Plans of Service. Considered substation locations, new feeder mains and distribution voltage levels; Selected Proposed Plan; Considered capital costs, cost of losses and operating costs; Detailed System Improvements with Cost Estimates.

Construction Work Plan & Borrowers Environmental Report, Hermiston Oregon
Managed development of Construction Work Plan of the Cooperative's transmission and distribution system. Performed a field survey of substations and feeders. Determined location and magnitude of future loads. Determined performance of the existing system for existing and future loads was determined. Developed a detailed plan for construction for calendar years 1999 and 2000. Prepared Borrower's Environmental report. Potential areas of environmental concern were identified and addressed. Mitigation activities were investigated.

Trinity PUD System Planning Study, Weaverville, California
Managed development of a series of long-range plans and several specialized studies which included a prioritized capital improvement plan, a replacement plan, and a cost / benefit analysis. Personally developed a set of contingency plans, made recommendations for improved VAR control, prepared substation one-line diagrams, provided an economic conductor size analysis, analyzed the life-cycle cost of losses for distribution transformers and analyzed the merits of implementing a pole treatment and testing program. Explored the feasibility of purchasing a mobile transformer.

Ocean Shores Distribution System Planning Study, Aberdeen Washington
Managed development of a long-range study of Ocean Shores portion of Gray's Harbor PUD's area. Personally analyzed the ability of the system to serve existing and future loads while adhering to a study specific planning criteria. Developed planning criteria which addressed reliability, capacity, voltage, circuit loads and pole lines per street. Considered various exploratory plans so that predicted loads could be served as per the planning criteria. Completed recommended plan with estimates in today's dollars for expansions and changes over a 10-year period.