

MEPPI - POWER SYSTEMS DIVISION



Flexible AC Transmission System Technologies (FACTS)

A Systems Studies Perspective

April 2003

Mitsubishi Electric Power Products, Inc.

MEPPI - POWER SYSTEMS DIVISION



For More Information, Contact:

John J. Paserba; Fellow Engineer

Power Systems Division

530 Keystone Drive, Warrendale, PA 15086

Phone: (724) 778-5219, Fax: (724) 778-5149

john.paserba@meppi.com

Home Page: www.meppi.com



FACTS Projects: Phases of Power System Studies

FACTS Projects: Phases of Power System Studies

- 
-
- ◆ **Phase 1: Initial Feasibility Studies to Determine System Constraints and Reinforcement Needs**
 - ◆ **Phase 2: Studies to Determine Type of Equipment, Location, and Ratings**
 - ◆ **Phase 3: Pre- Specification Studies for Defining Equipment Requirements**
 - ◆ **Phase 4: Pre-Manufacturing and Equipment Design and Verification Studies**
 - ◆ **Phase 5: Studies for Post-Commissioning System Operation**

Studies for FACTS Projects



Phase 1

**Initial
Feasibility
Studies**

Phase 2

**Studies to
Determine Type
of Equipment,
Location, and
Ratings**

Phase 3

**Pre-
Specification
Studies**

Phase 4

**Pre-
Manufacturing
and Equipment
Design and
Verification
Studies**

Phase 5

**Studies for Post-
Commissioning
System
Operation**


**Typically By Owner or
Owner/Consultant**

**Typically By
Owner or
Consultant**


**Typically By
Vendor**

**Typically By
Owner**


Key Objectives for Phase 1 Type Studies

- 
-
- ◆ **Identify Characteristics of the Power System**
 - ◆ **Identify System Performance Problems**
 - ◆ **Transient instability**
 - ◆ **Oscillatory instability**
 - ◆ **Dynamic voltage instability**
 - ◆ **Voltage collapse**
 - ◆ **Thermal ratings (power flow)**
 - ◆ **Identify which Transmission Constraints that can be Examined Independently and which Require a Coordinated Analysis**
 - ◆ **Identify the Reinforcement Needs (Shunt vs. Series and Fast vs. Slow)**


Key Objectives for Phase 2 Type Studies

- 
-
- ◆ Identify Solution Options, both Conventional and FACTS and Combinations Thereof
 - ◆ Evaluate Performance of Solution Options
 - ◆ Consider Other Issues
 - ◆ Location
 - ◆ Economics of the solution options
 - ◆ Losses
 - ◆ Interaction with other devices
 - ◆ Etc.
 - ◆ Evaluate Economics of Each Option's Costs vs. Value of Power System Benefits


Key Objectives and Approach for Phase 3 Type Studies

- 
-
- ◆ Overall Purpose of Phase 3 Type Studies is to Be Able to Write a Technical Specification and RFP to Submit to Potential Bidders
 - ◆ Studies are Typically Done By the Owner or by Consultant or a Combination Thereof

Objectives for Phase 4 Type Studies

- 
-
- ◆ **To Verify to the Owner that the Device Described by the Specification Meets all System and Equipment Performance Requirements**
 - ◆ **To Complete the Detailed Design for Equipment Manufacturing and Procurement for:**
 - ◆ **Control and Protection (Hardware and Software)**
 - ◆ **Insulation Coordination**
 - ◆ **Inverters**
 - ◆ **Filters**
 - ◆ **High-voltage and low-voltage equipment**
 - ◆ **Etc.**

Key Objectives for Phase 5 Type Studies

- 
-
- ◆ **To Confirm the Network Loadflow Conditions are Within Benchmark Limits**
 - ◆ **To Confirm Installed Equipment is Effective to Enhance Network Steady-state and Dynamic Performance**
 - ◆ **To Setup Instrumentation and Obtain Measurements During Staged Fault Tests and Actual Faults/Dynamic Events**
 - ◆ **To Ensure There are no Adverse Interactions with Other System Equipment**
 - ◆ **To Measure Reliability/Availability of Equipment**
 - ◆ **To Establish Operational Losses Algorithm**