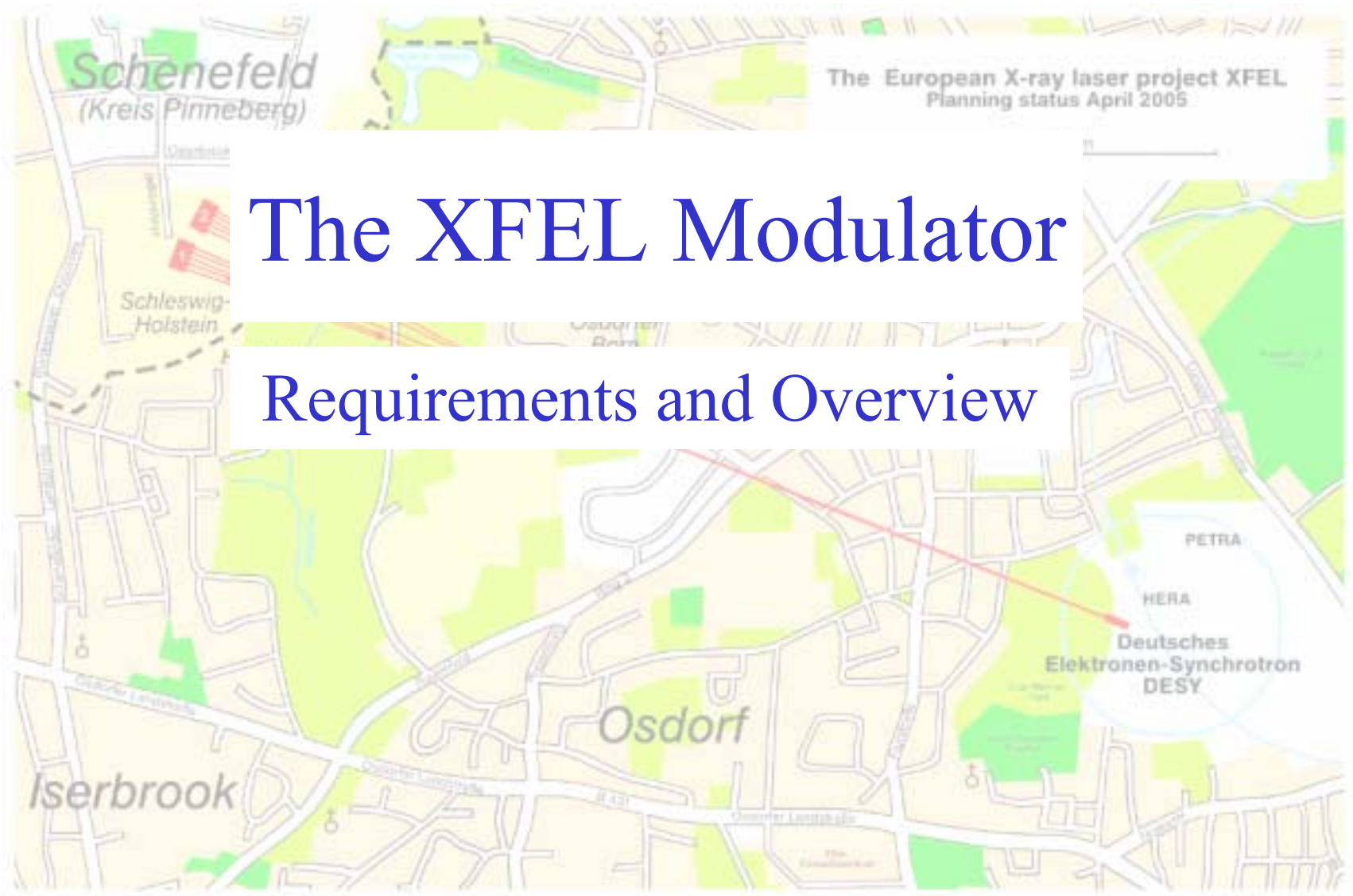


The European X-ray laser project XFEL
Planning status April 2005

The XFEL Modulator

Requirements and Overview



Overview

- Introduction
- Requirements
- Preferred Solution
- Modulator Test Facility
- Schedule and Progress
- Summary

Introduction

- The X-ray free-electron laser (XFEL) planned at DESY in cooperation with European partners needs ~ 30..40 Radio Frequency (RF) Stations for generating high power RF bunches using klystrons
- Part of the XFEL RF Stations will be the Modulator which produces High Voltage pulses for the klystron
- Modulator will be integral part of the whole RF Station (LLRF, klystron, pulse transformer, control, Interlock) and has to fulfil a lot of requirements

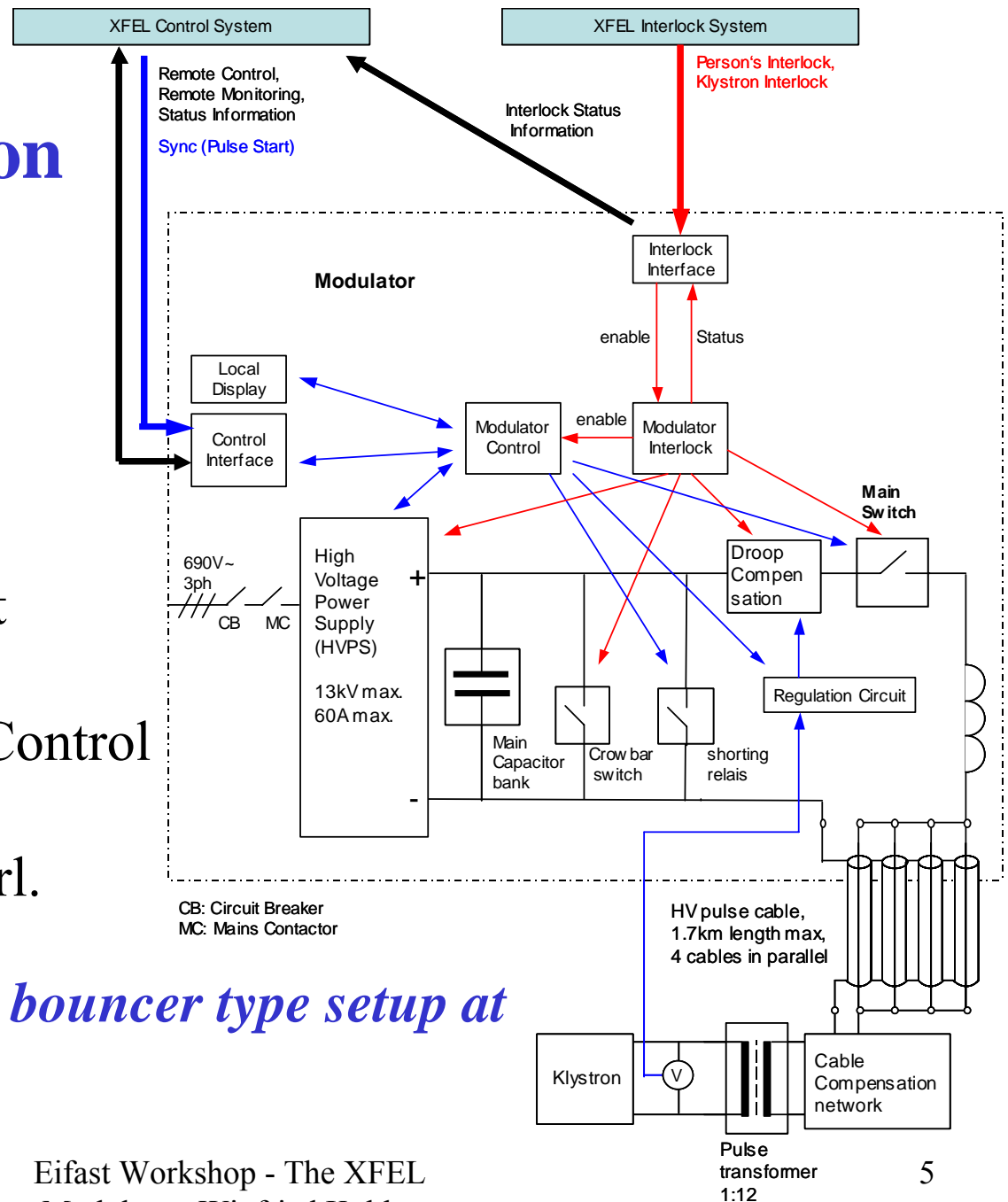
Main Requirements

- Connected to klystron via pulse cable, cable compensation network and pulse transformer (ratio 1:12)
 - HV pulse transformer output : $\leq 130\text{kV}$, $\sim 16\text{ MW}$ peak
 - HV modulator output : $\leq 12\text{kV}$
 - Modulator mean output power : $\leq 280\text{kW}$
(limited by klystron collector)
 - Pulse length : $\leq 1570\mu\text{sec}$
 - Pulse repetition rate : 1 - 30Hz
(limited by klystron mean power, pulse length and pulse voltage)
 - Pulse flatness, pulse to pulse stability, high availability, modular design (fast and easy repair)
- *There are a lot of other requirements which are not listed here*

Preferred Solution

Main Components:

- HV power supply
- Main Capacitor Bank
- Main Switch
- Droop compens. circuit
- Crowbar Switches
- Internal Interlock and Control
- Connections to ext. Interlocks and Rem. Ctrl.



→ *Experiences with bouncer type setup at TESLA Test Facility*

Bouncer Type Modulator

- experiences/meas. results of that modulator technology
- Modulators produced by PPT and Fermilab type used at TTF / Flash

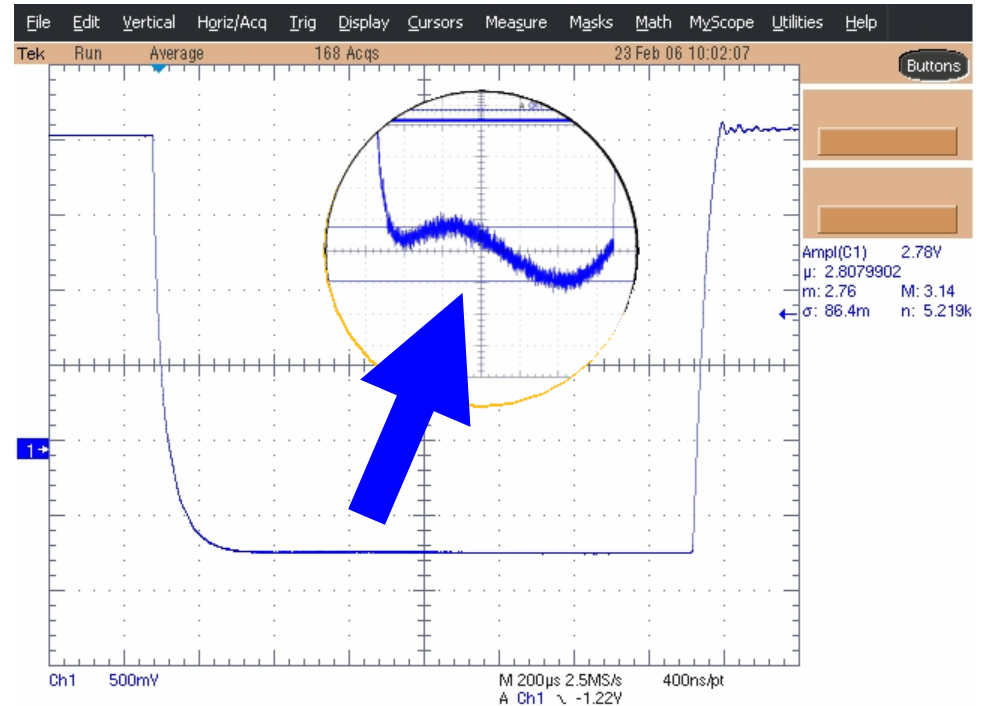


Bouncer Type Modulator
used at TTF / Flash



High Voltage Pulse Shapes

- pulse flatness 0.3%
- pulse to pulse fluctuation $\leq 0.1\%$
- rise and fall time 20..70 μ sec



Pulse flatness < 0.3% (flat top)

Date: 2006-02-23, PPT Modulator PITZ RF-2

Modulator Test Facility

- XFEL Modulator – a complex system
 - Testing the devices in a *complete RF system setup* is desirable but not possible at the manufacturer (LLRF, external control)
 - perform precision measurements → special equipment needed
 - tests have to be done to investigate into open technical details
 - long term testing
 - integrating the modulator control into the DOOCS environment
 - final goal: improve (optimize) the final design of the XFEL modulator
- *Will be tested in a special Modulator Test Facility at DESY*

Modulator Test Facility (contd.)



2006-02-14

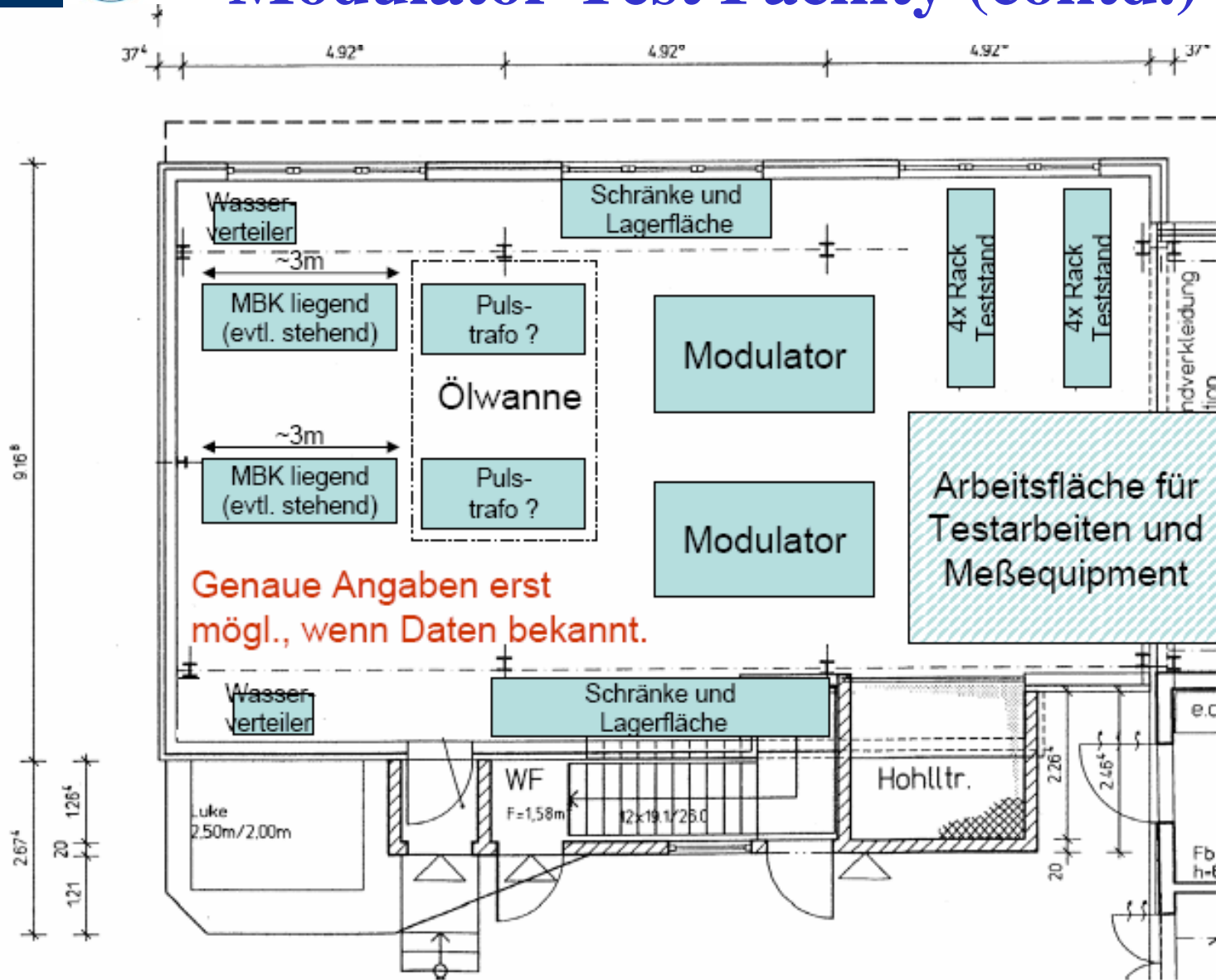
2006-05-04



2006-05-09

Eifast Workshop - The XFEL
Modulator, Winfried Köhler

Modulator Test Facility (contd.)



Schedule

- Prototype Tests and detailed study within the next two years, finished in 2008
- Request for quotations expected for 2008
- Factory Acceptance Tests and Side Acceptance Tests
- First delivery of Modulators in 2009 (Module Test Facility)
- Main delivery of 30..40 Modulators 2010-2011
- Latest parts delivered in 2012

→ Start commissioning of RF stations planned as soon modulators and other parts arrive

Summary

- Modulator Specification is done
- Prototypes will be evaluated next two years
- Schedule shown
- Principle tested at TTF/Flash

Thank you for attention.