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CONCEPTUAL DESIGN OF POWER SUPPLY CONTROL SYSTEM FOR ILSF

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Abstract

The Iranian Light Source Facility (ILSF) project is a first large scale accelerator facility which is currently under planning in Iran. On the basis of the present design, circumference of the 3 GeV storage ring is 528 m. Beam current and natural beam emittance are 400 mA and 0.27 nm.rad respectively. The facility will be built on a plot of land the size of 100 hectares in the city of Qazvin, located 150 km West of Tehran. In this paper the conceptual design of power supply control system is presented.

INTRODUCTION

Synchrotron radiation, as a versatile research tool, has experienced an unprecedented expansion. Nowadays, a large and continuously growing community of researchers representing a variety of disciplines depends on light sources as an essential part of their research programs. In spite of innumerable applications of synchrotron radiation, a large portion of the world namely Middle East is unfortunately poor on modern synchrotron light source facility.

Following SESAME project which was dedicated by UNESCO to the Middle East countries [1], several countries of the region such as Armenia [2] and Turkey [3] have planned to have their own synchrotron radiation facility.

The Iranian Light Source Facility (ILSF) project [4] was initiated in 2003 and formally approved by the Iranian government in 2008 [5-6].

At the end of 2009, Institute for Research in Fundamental Sciences (IPM) was selected to plan, construct, equip, and exploit the facility.

The ILSF is conceived as a national synchrotron light source to provide a powerful source of x-ray for the users and cover requirements of the experimental science in several fields.

The figure of merit of the ILSF storage ring follows modern synchrotron light sources design trend. To have a competitive leading position in the future, the ILSF is designed to emphasize small emittance electron beam (below than 0.27 nm.rad), high photon flux density, brightness, stability and reliability.

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OVERVIEW OF ILSF P.S.

This section is presented to check out the ILSF booster Table 1 and storage ring Table 2 power supply specifications.

Table 1: ILSF Booster Ring Power Supplies

Booster Ring P.S.	Dipole	Quadrupole	Sextupole
Output current	484A	202.4 A	22.82 A
Output voltage	1135.41V	401.45 V	101 V
No. of Power Supplies	1	1	1

Table 2: ILSF Storage Ring Power Supplies

Storage Ring P.S.	Dipole	Quadrupole	Sextupole(S4)
Output Current	364.3A	132.3A	125 A
Output Voltage	640V	15 V	1108.8 V
No. of Power Supplies	2	240	6

OVERVIEW OF POWER SUPPLY CONTROL SYSTEM

The P.S. control system consists of three parts:

- ✓ Internal Control Module
- ✓ Analog to Digital Converter
- ✓ Digital to Analog Converter or High Resolution PWM

Figure 1 proposes an architecture of digital current regulator intended to be used to control the power supplies of the Iranian Light Source Facility. It is based on a high-precision Digital to Analog Converter and a high performance digital control system. This control structure will be used to control the current of the most types of power supplies either in Storage or Booster Ring.

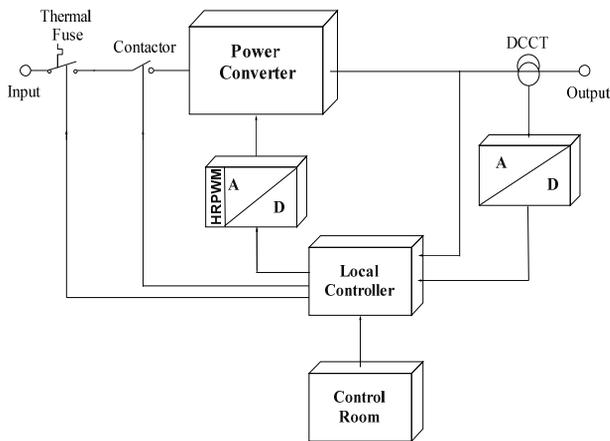


Figure 1: Power supply control system.

CONTROL CONCEPT

The goal was to find a simple but robust control structure that fulfils the high demands. This resulted in a nonlinear PI-structure of the well known form of Figure 2 For the suppression of the dc-link ripple a nonlinear feed forward is implemented. In addition, a limiter for the du/dt was necessary to protect the output filters of the P.S. d/dt -limiters and filters for the reference value, as well as for the measured properties, are needed. Last but not least, an anti wind up feed back is implemented.

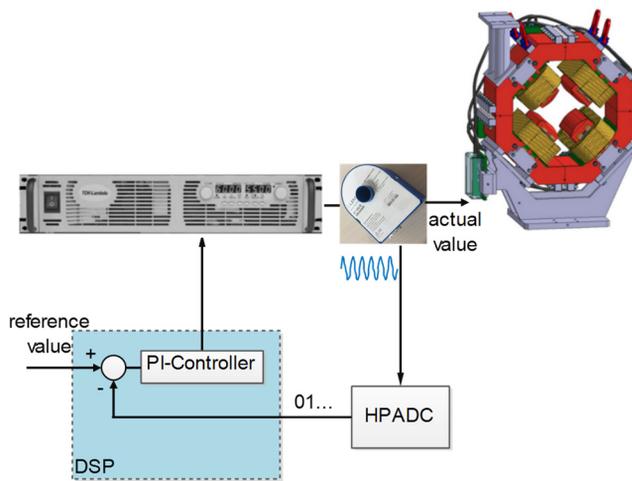


Figure 2: Basic structure of the closed of the P.S.

PI-Controller

The coefficients of the PI-Controller are determined in a proven way: Of the entire P.S. a linear model is derived. From this model the open loop frequency response is simulated. According to the rules of Bode the P- and I-coefficients are determined for various points of operation.

ADC-/DAC Module

The ADC's are the key parts for the necessary precision of the entire controller. Especially for the current measurement (the output property of the power supply) a final resolution of less than 10 ppm is required, asking for 17 bits plus sign. The DAC is more relax than the ADC, because the control system can compensate its thermal drift and resolution, but still we need a perfect DAC for control system.[7]

CONCLUSION

The Control System is based on a High-precision Digital to Analog Converter and a high performance digital control system. This control structure will be used to control the current of the most types of ILSF Power Supplies.

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