iDREAM: an industrial detector for nuclear reactor monitoring.

1I V Gribov, 2M B Gromov, 3G A Lukjanchenko, 4G J Novikova,
3,a B A Obinyakov, 3,b A Y Oralbaev, 3,5,c M D Skorohvatov,
3S V Sukhotin, 1,d A S Chepurnov and 3 A V Etenko

1Skobeltsyn Institute of Nuclear Physics, Moscow State University, Moscow, 119991
Russia
2Department of Physics, Moscow State University, Moscow, 119991 Russia
3NRC "Kurchatov Institute" , 123182, Moscow, Russia
4Institute for Nuclear Research, Russian Academy of Sciences, Moscow, 117312 Russia
5National Research Nuclear University MEPhI (Moscow Engineering Physics
Institute),
Kashirskoe highway 31, Moscow, 115409, Russia

E-mail: a b.obinyakov@yandex.ru, boralbaev_ay@nrcki.ru, cskorokhvatov_md@nrcki.ru,
daschepurnov@gmail.com

Moscow, 7th October 2015
Introduction

1970s – the neutrino diagnostic method proposition by L. Mikaelyan and A. Borovoj


From 1982 to 1995 – Feasibility studies were provided at Rovno NPP

Monitoring method

Inverse beta-decay is the cornerstone of the method:

\[ \bar{\nu}_e + p \rightarrow n + e^+ \]

Dependence of neutrino events number for 1 day from generated energy \( W \):

\[ N = \gamma \times A \times W \]

where \( A \) is a coefficient, \( \gamma \) is a correction which takes into account the nuclear fuel alteration.
Project Goal

the Federal program "Development the nuclear power complex"
the Federal Targeted Program "The nuclear technologies of the new generation for the time period from 2010 to 2015 and for the period until 2020"

- Industrial type detector which meets different requirements from research detectors ("black-box", long-term stability and etc.)
- Development of a collective-use laboratory (reconstruction of the lab at the Rovno NPP);
- Possible complete equipment for unified future PWR-1000 reactors.
iDREAM –
industrial Detector for Reactor Neutrino Monitoring

Skobeltsyn Institute Nuclear Physics
MSU, NRC “Kurchatov Institute”,
Institute for Nuclear Research of the RAS
iDREAM construction

- Membrane with a vertical pipe for accessing the target
- Header
- LOS and nitrogen pipelines
- Target 1 m³
- Flasher for adjusting and testing the target PMTs
- Sealed cap with PMTs
- Light-protective cover
- Buffer volume
- Circular separators for bubbling

Dimensions:
- $H = 1643$ mm
- $\varnothing 1310$ mm
- $\varnothing 1914$ mm
Liquid organic scintillator

$\sigma \sim 250000\sigma$ the neutron-capture cross section with gadolinium

LAB + PPO(3g/L) + POPOP(0.03g/L) – master solution

Three Gd samples:

- Gd(TMHA)3 + TMHA
- Gd(TMHA)3
- Gd(TMHA)3 + TGP

The relative light output of the LOS with the Gd(TMHA)3 complex.

Summary

• Developed and adjusted detector construction
• The first physical start with distilled water carried out.
• Three LOS Samples are testing.
• Future shift to an underground laboratory in SINP MSU.
• Future in-situ experiment on NPP.

Acknowledgments
This study was supported financially by the Russian Foundation for Basic Research, grants 14-22-0301 o m and 14-02-31381 mol a.
Thank you for your attention.