Brief Gd Introduction

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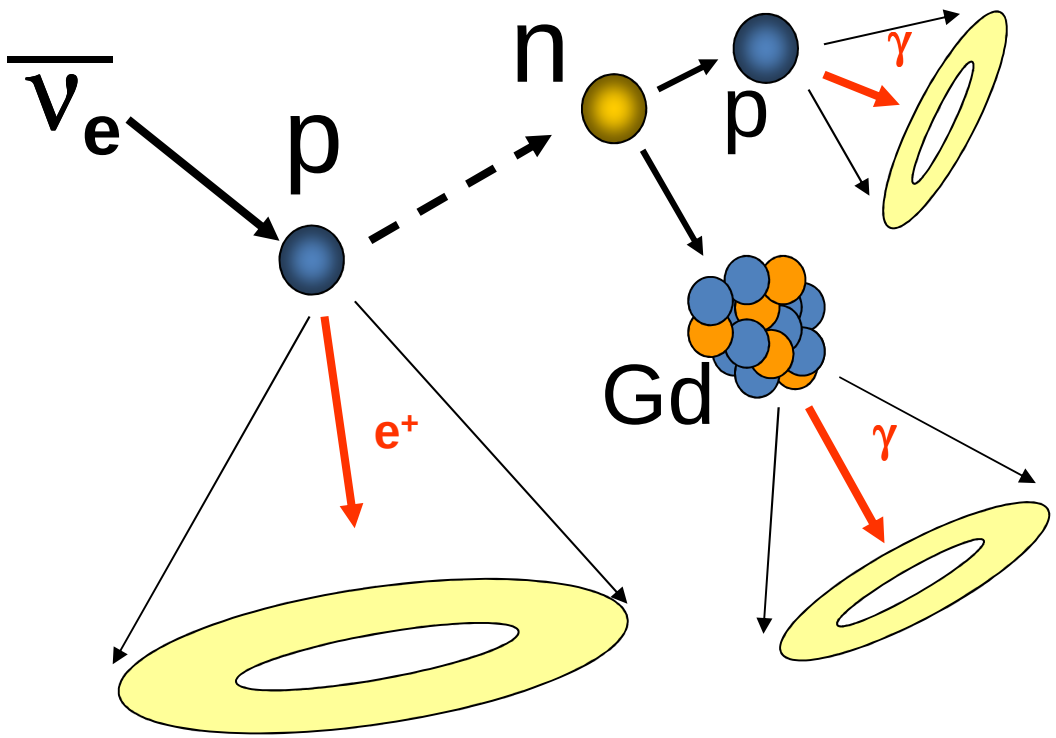
Slides from many others

Neutron tagging in a Gd-enriched WC Detector



Possibility 1: 10% or less

$n+p \rightarrow d + \gamma$

2.2MeV γ-ray

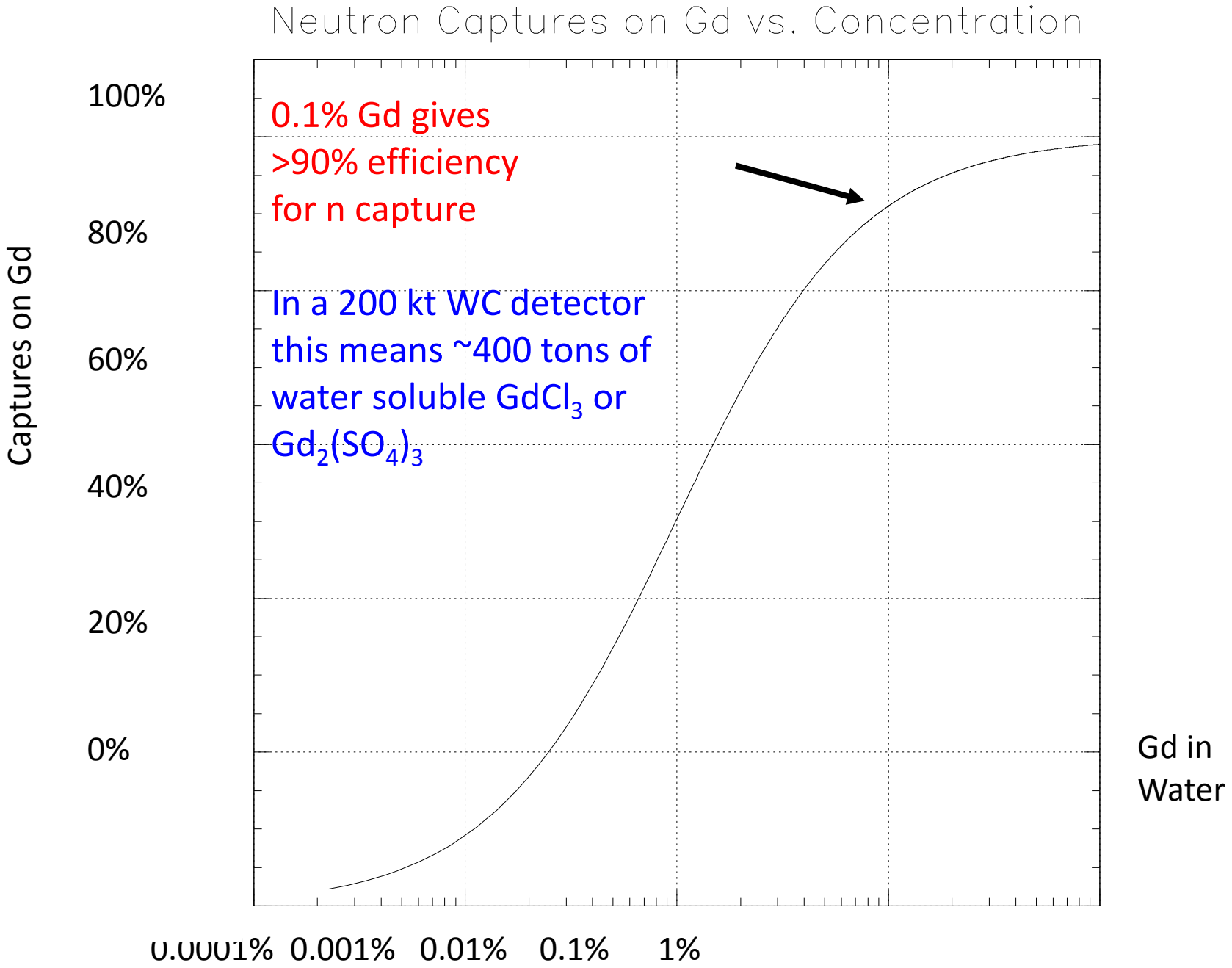
Possibility 2: 90% or more

$n+Gd \rightarrow$ ~8MeV γ

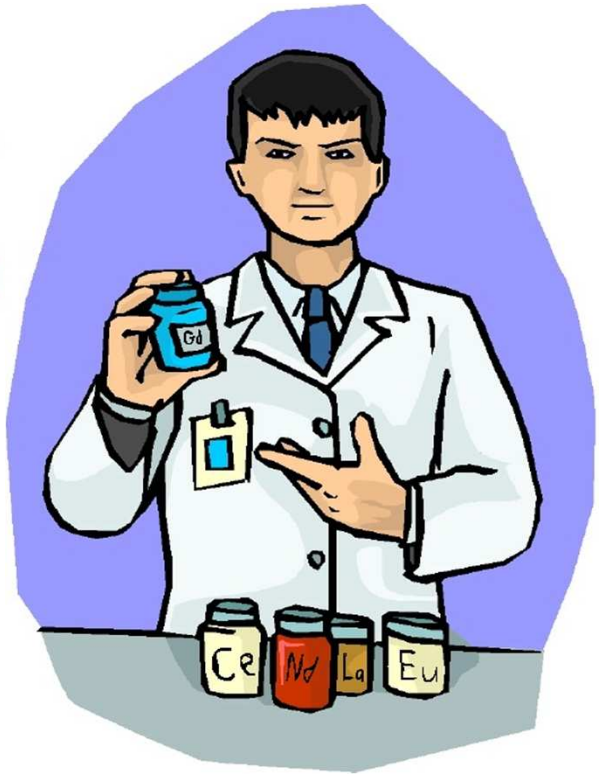
ΔT = ~30 μsec

Positron and gamma ray vertices are within ~50cm.

$\overline{\nu}_e$ can be identified by delayed coincidence.

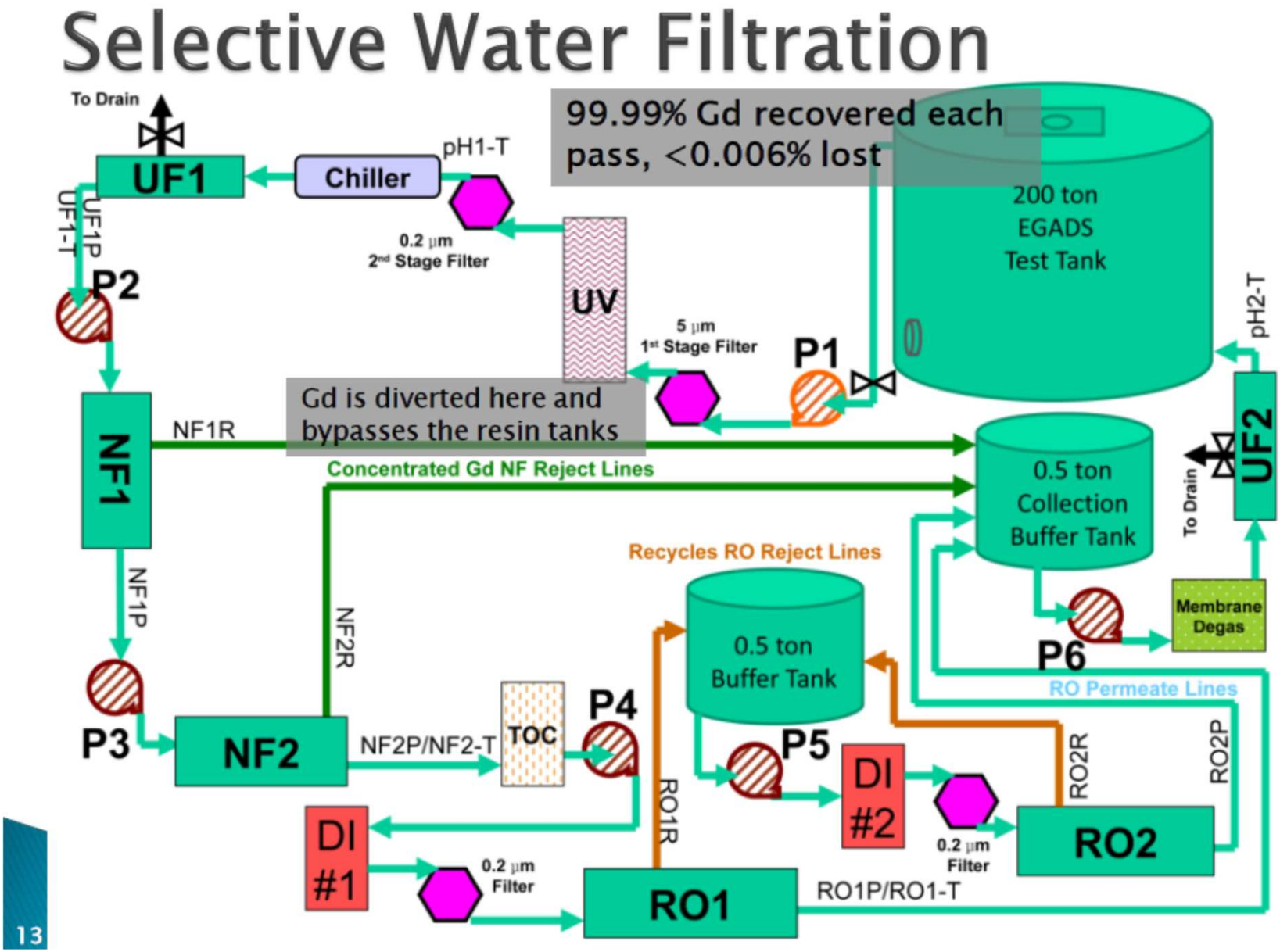

Neutron Captures on Gd vs. Concentration
0.1% Gd gives
>90% efficiency
for n capture
In a 200 kt WC detector
this means ~400 tons of
water soluble $GdCl_3$ or
$Gd_2(SO_4)_3$
Captures on Gd
100%
80%
60%
40%
20%
0%
0.0001%
0.001%
0.01%
0.1%
1%
Gd in
Water

Wait, didn't you just say 400 *tons?*
What's <u>that</u> going to cost?



In 1984: $4000/kg –> $1,600,000,000
In 1993: $485/kg –> $194,000,000
In 1999: $115/kg –> $46,000,000
In 2010: $6/kg –> $2,400,000

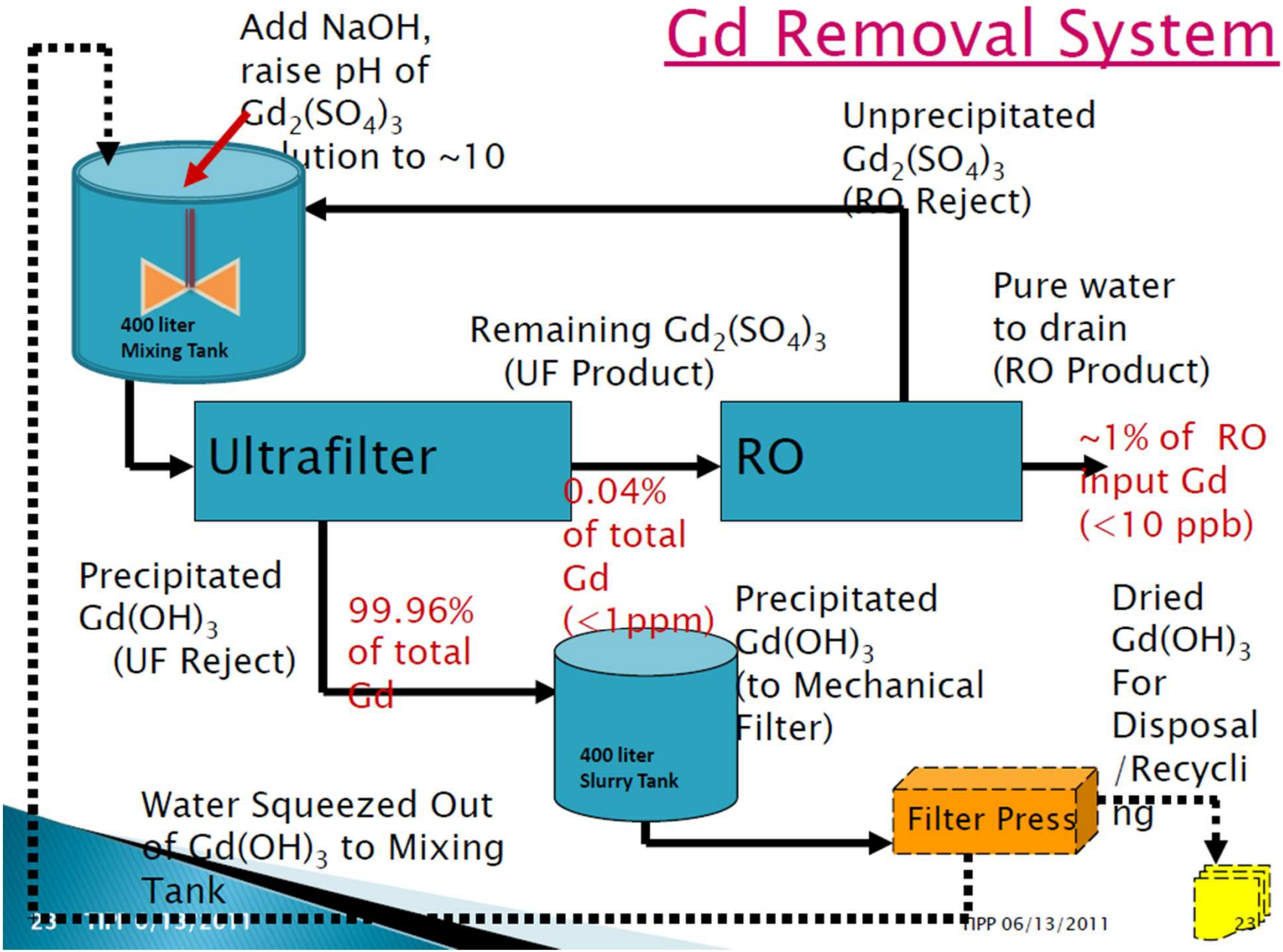
Underground separation



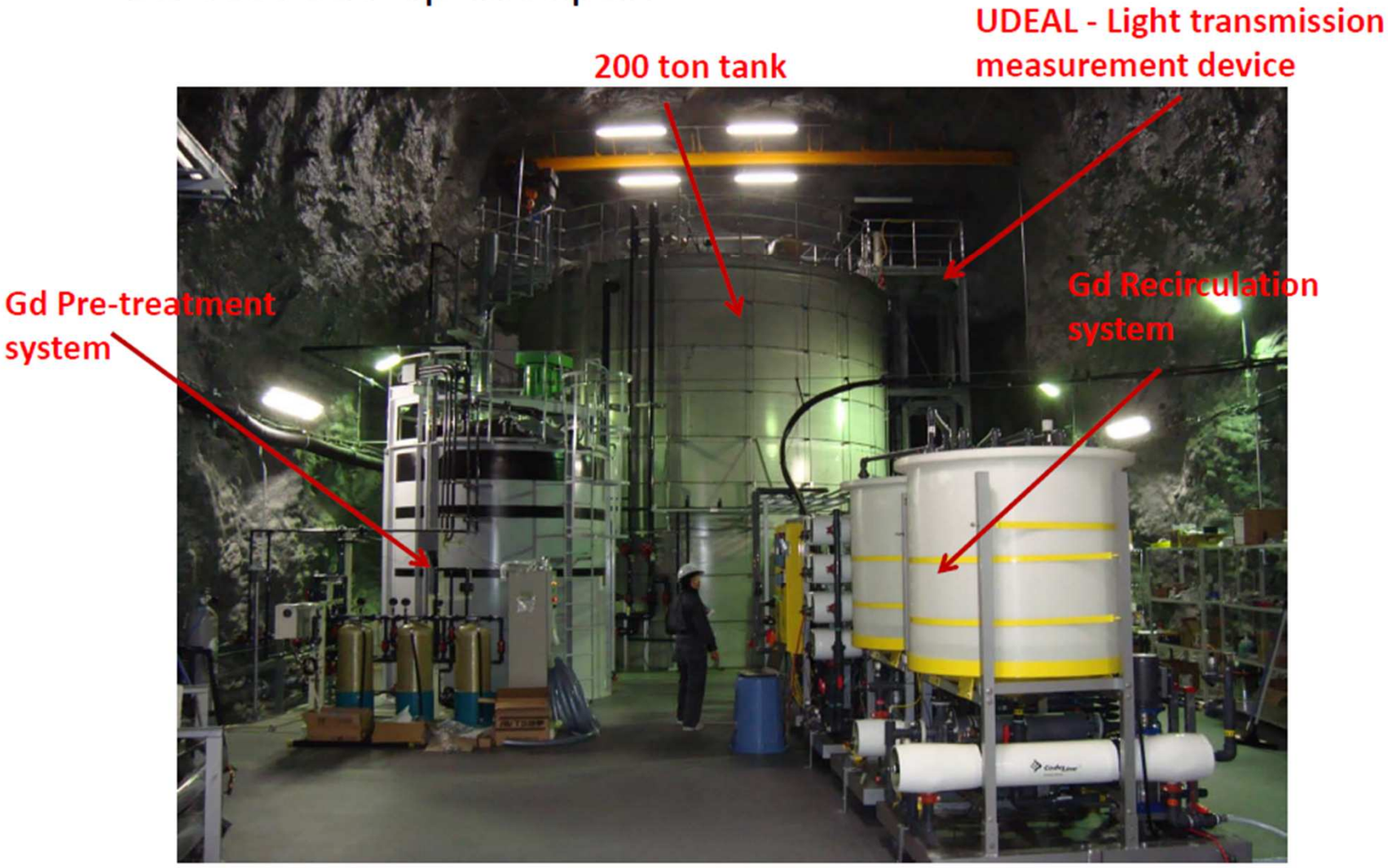
Selective Water Filtration

Membrane Type	Gd Remaining in Product Stream vs. Original Tank Concentration	SO_4 Remaining in Product Stream vs. Original Tank Concentration	Gd in Reject Streams	SO_4 in Reject Streams
NF Stage 1 (Nitto)	0.15%	<0.11%	99.85% (returned to "SK" by NF1)	>99.89% (returned to "SK" by NF1)
NF Stage 2 (Nitto)	<0.006% (this is what is lost)	<<0.11%	>99.994% (returned to "SK" by NF1+NF2)	>>99.89% (returned to "SK" by NF1+NF2)

Surface Removal



Gd Test Set-up in Japan



Gd needs

- Space at 4850 - 250 m2 in drifts 625/636
- Space at pumping levels – 40 ft2 + electrical space at each level
- Power available to feed infrastructure at 4850 (cables no switchgear) ~ 450 kW (chiller, 2 pumps, added PMTs)
- Power at pumping levels ~ 400 to 600 kW total combined
- Addition load support at deck/floor for added PMTs (TBD)

Included in current RFQ
Not included in current RFQ