Orion Support Laser

Overview & Safety Issues

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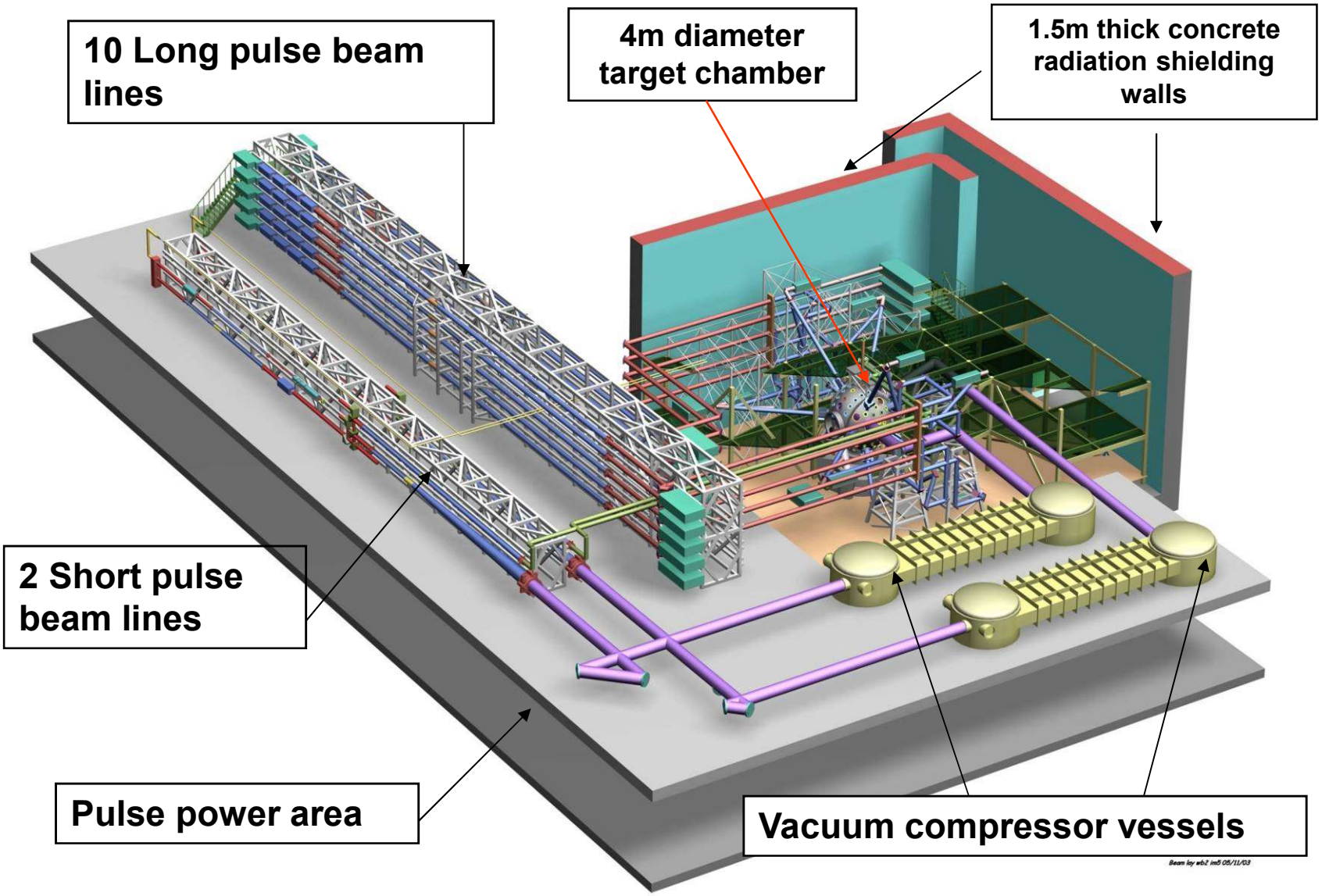
MER-150-001

Overview of the talk

- Why do we need it ?
- An overview of the laser.
- Safety issues and potential solutions.
- Where we are and the way forward.

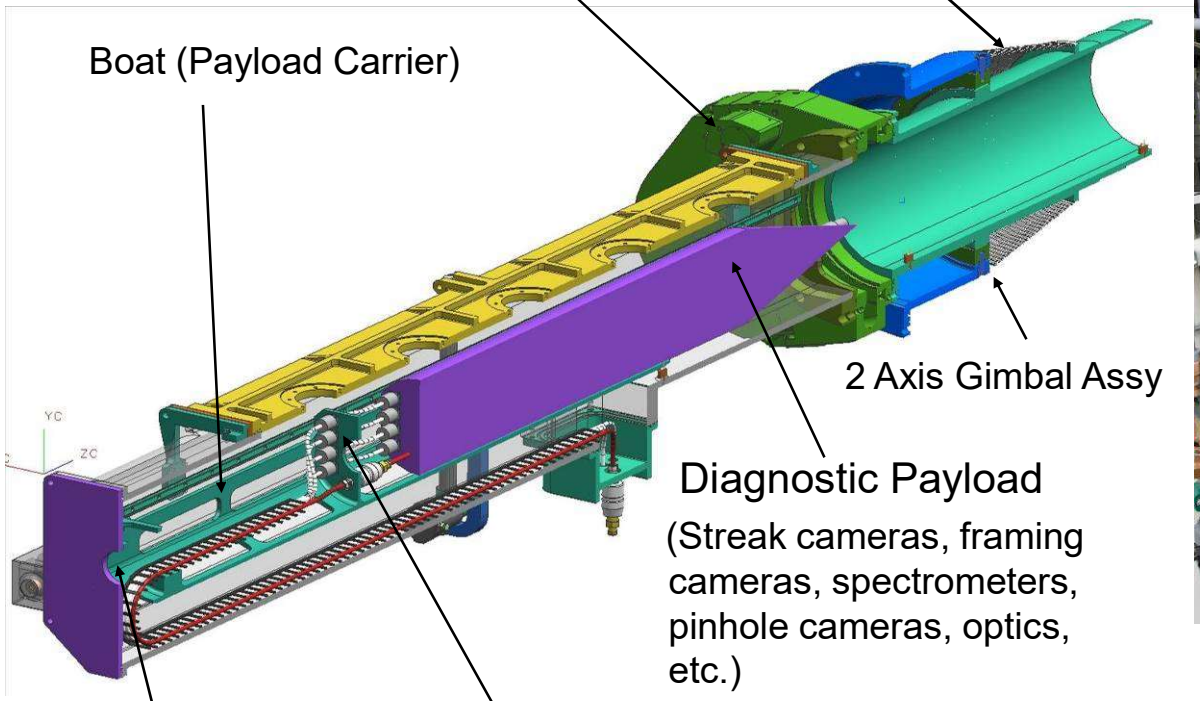
Orion overview

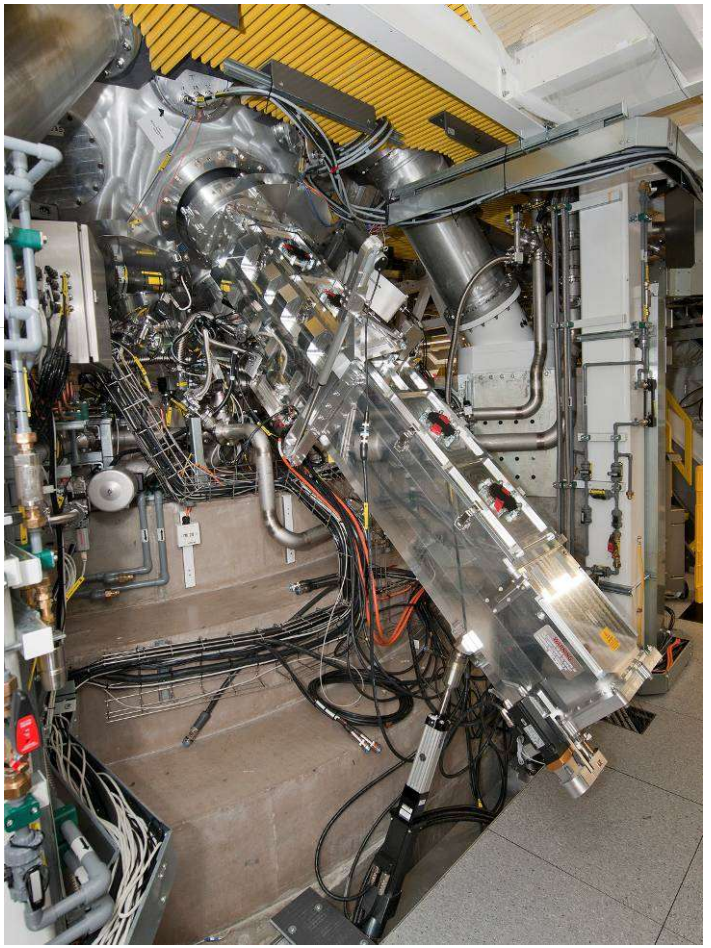


Why do we need it?

- Diagnostics:
  - pre-experiment testing and set up.
  - development of new diagnostic systems
- Prove experiments set-ups prior to fielding on Orion.
- Gives ability to undertake smaller scale experiments.
- Orion Mid life upgrade (approx 2022), maintain capability.

Orion TIM General Overview





Orion Support Laser - Overview

- High repetition rate system for low energy short pulses at 1ω, 2ω and 3ω (1053nm being the fundamental) - 2500 shots/year.
- Nd:glass, Chirped Pulse Amplification (CPA).
- Short pulses (~300 fs to 1 ps) at 1053 nm at >50J.
- Short pulses at 527nm at highest energy possible.
- Long pulse (200ps to 5ns) at 351 nm (>50J).
- Long pulses at 1053 nm (>50J).

Orion Support Laser - Position

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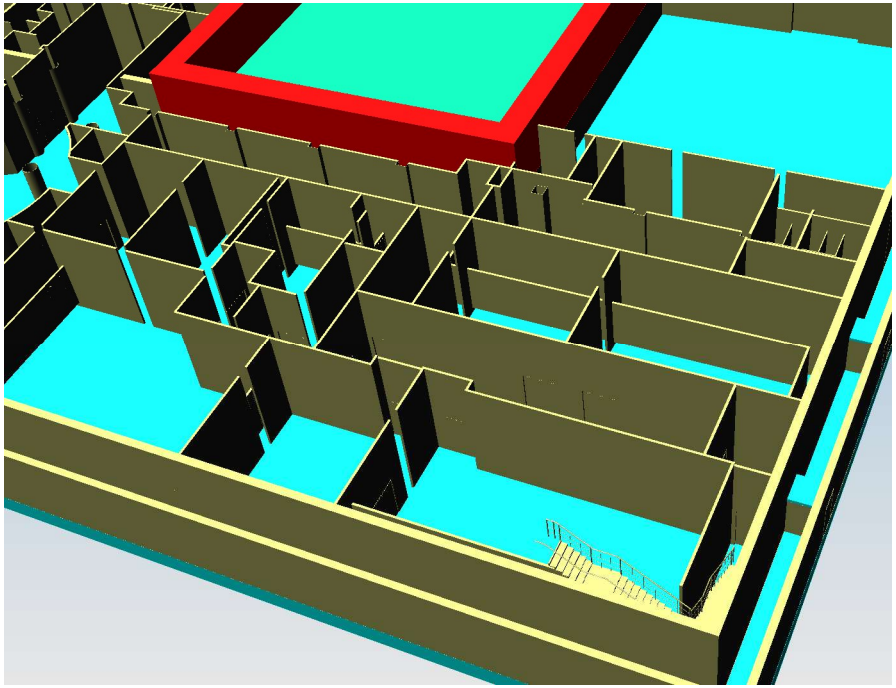

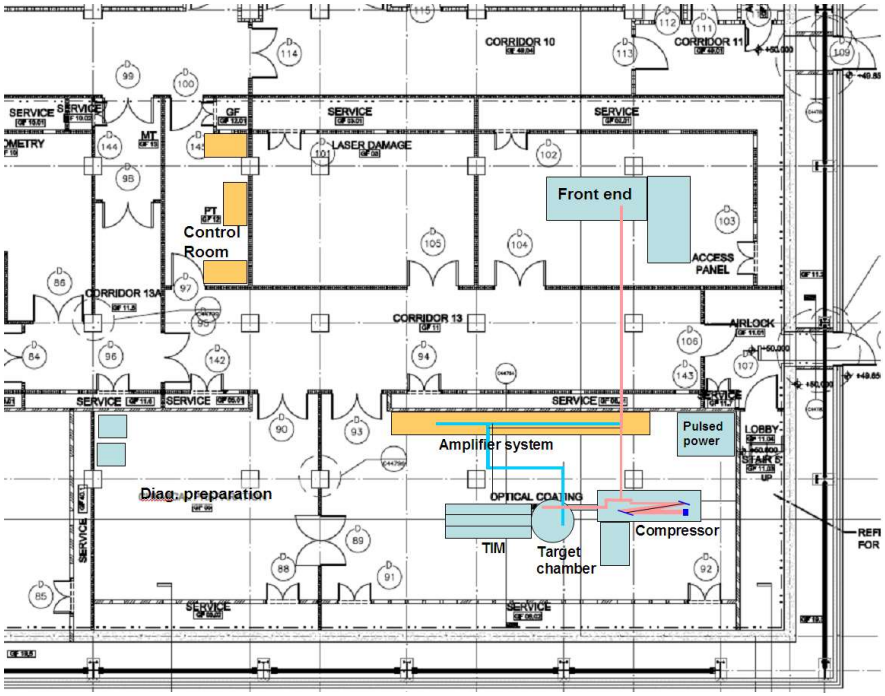

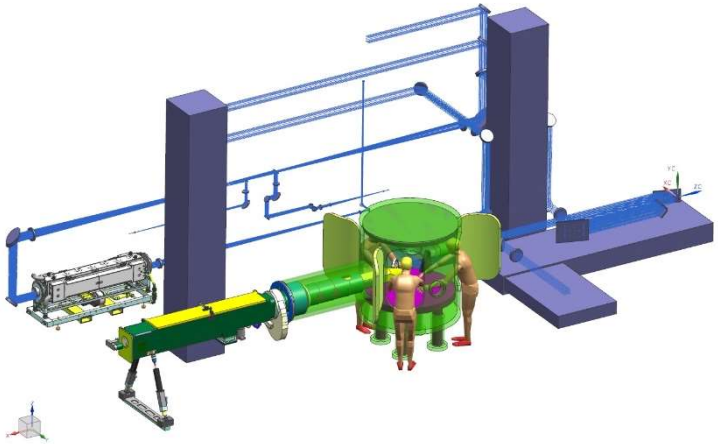

Risk assessed based design process

Health and Safety at Work (HSW) Act 1974 Act of Parliament is the main piece of UK health and safety legislation. It places a duty on all employers "to ensure, so far as is reasonably practicable, the health, safety and welfare at work" of all their employees.

The Management of Health and Safety at Work (MHSW) Regulations 1999 require all employers to assess the risks from their work on anyone who may be affected by their activities

There are 8 steps to carrying out a risk assessment;

- Identify the hazards
- Identify those at risk
- Identify existing control measures
- Evaluate the risk
- Decide/Implement control measures
- Record assessment
- Monitor and review
- Inform

Risk Assessment Methodology

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Identify the hazards

A hazard is a situation or a condition with the potential for harm! Find out what the significant hazards associated with the task or processes are.

- Workforce
- Accident, ill health and near miss data
- Data sheets – COSHH
- Hazard Crib sheets
- Workplace inspections

Identify those at risk

Think about individuals or groups of people who may be affected e.g.
Scientists & technicians
Maintenance personnel
Visitors
Particular attention must be paid to lone workers, temporary staff and young inexperienced workers.

Identify Existing Control Procedures

Examine how you already control the risks; it is unlikely that your workers are getting injured on a daily basis, so you must have some controls in place already.

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Evaluate the risk

A risk is defined as the likelihood that a hazard will cause harm i.e. Risk = Likelihood x Severity - below is an example of a simple 1-5 risk ranking system.

How likely is it that the hazard may result in harm? Is it;
1.Highly Unlikely
2.Unlikely
3.Possible
4.Probable
5.Certain

If the hazard does result in harm, how severe would the injury be?
1.Scratch (trivial)
2.Cut (Minor injury)
3.Fracture (Major injury - Over 3 day injury)
4.Amputation (Major injury)
5.Death (Death)

Likelihood	Severity				
	Trivial	Minor Injury	Over 3 Day Injury	Major Injury	Incapacity or Death
Highly Unlikely	1	2	3	4	5
Unlikely	2	4	6	8	10
Possible	3	6	9	12	15
Probable	4	8	12	16	20
Certain	5	10	15	20	25

Priority
1 Urgent Action - (Risk no 15 - 25)
2 High Priority - (Risk no 10 - 12)
3 Medium Priority - (Risk no 5 - 9)
4 Low Priority - (Risk no 2 - 4)
5 Very Low Priority (Risk no 1)

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Decide and Implement new control measures
If the risk is not adequately controlled decide which new control procedures are required and ensure these procedures are implemented.

When deciding what new control measures will be required, it is helpful to work through the 'hierarchy' of controls.

E	Eliminate
R	Reduce
I	Isolate
C	Control
P	PPE
D	Documentation

Record the assessment
Keep copies of the assessments for your records and for inspection by the HSE should they ever be requested

Monitor and review
You must ensure that the control measures are achieving the desired level of control. You must review the assessment on a regular basis or if anything changes e.g. new staff, change in machinery or process.

Inform
Legal duty to relay the findings of the assessment to everyone who is affected by it.

Safety/Environmental Issues

- Laser
- Radiological
- Environmental - Radioactive gaseous discharge from non metallic targets.
- High Voltage and Stored Energy
- EMP

Safety/Environmental Issues

- Laser — BEAM
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NON BEAM

Laser

Main concern front end development:

- Nature of work (development).
- Multiwavelength: 1053nm, 527nm, 351nm (800nm pump leakage)
- High energy: 1053nm, 5J, 3ns, 10Hz, 10mm.
- Laser Protective Eyewear requires additional testing by manufacture.
- Low VLT of Eyewear (7%).
- Additional Eyewear type in facility - increased possibility of using wrong eyewear.
- Interlocking requirements SIL 2 - 3 required.
    - (SIL 3 potential due to high demand).
- Normal laser safety issues.

Radiological

Issues:

- Prompt dose approx estimate 20mSV (2 rem).
- Basic Safety Objective to operators - 0.5 mSV/year (50mrem).
- Room/building layout – close proximity of workers around TC and above.
- Neutron shielding required.
- High shot rate: 2500/year.
- Activation of materials.
- Shielding 1200mm concrete -100mm lead.
- Substantial weight of shielding on foundation. >2000T
- Environmental discharge from target material: Decay/delay tanks

Radiological

Proposed solutions:

- Prompt dose approx estimate 20mSV (2 rem).
  - » It is what it is.
- Basic Safety Objective to operators (facility) - 0.5 mSV/year (50mrem).
  - » Shielding and target area exclusion.
- Neutron shielding required.
  - » Removed from project – not feasible, facility constraints.
- Facility layout – close proximity of workers (5m).
  - » No scope to change, facility constraints.
- High shot rate: 2500/year.
  - » Not a big impact on shielding requirement.

Radiological

Proposed solutions:

•Activation of materials.

- Known issue.

•Shielding approx 1200mm concrete -100mm lead.

•Use of building fabric as shielding.

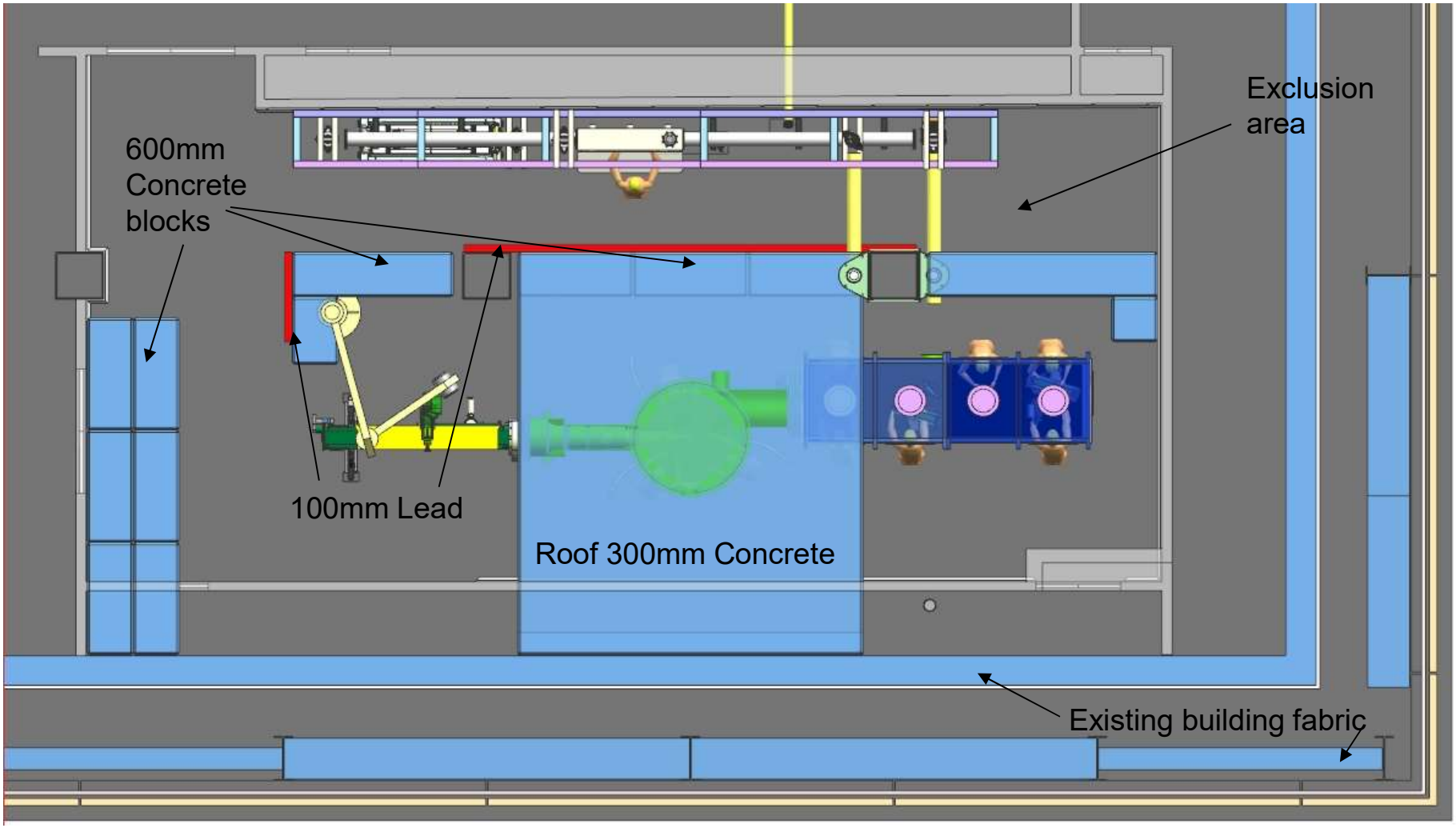
•Substantial weight of shielding on foundation. >2000T, actually improves stability.

•Environmental discharge from target material.

- Decay/delay tanks to be employed. Discharge eliminated.

We have a solution……

Radiological - Shielding



High Voltage & Stored Energy

No real concerns:

- All high voltage and stored energy contained within Target Area.
- Not energised when personnel present.
- Automatic dumping and shorting.
- Voltage indication.
- All diagnostics limited current.

EMP

- Two documents exist describing the permissible exposure of people to electro magnetic fields (EMFs):
  - Limits for human exposure to EMFs are specified in “Directive 2013/35/EU Of The European Parliament And Of The Council of 26 June 2013”
  - Guidance issued by ICNIRP (International Commission on Non-Ionising Radiation Protection) [8]..
- Orion is fitted with an expensive EMP shield to protect people: It was very expensive and do we need one for OSL?
- OSL field strength estimate from data extrapolated from measurements taken on Orion -at 5m there will be no issue to personnel,
- Standard EMP equipment protection will be provided.

Where we are and the way forward

- Basis of design near completion.
- Shielding issues resolved.
- Facility interfaces outlined.
- Project put on hold until April 2017.

THANK YOU FOR YOUR TIME

ANY QUESTIONS