building advanced lead reactor

2025-08-26

Introduction

Blykalla is based on 25 years of research and 11 years as a company - developing key patents until commercialization phase started in 2022

Research and IP development

Commercialization phase starts

2013

New corrosion-resistant FeCrAl steel developed by the CRO of Blykalla and his group at the Royal Institute of Technology (KTH) in Stockholm, Sweden

2016

Novel manufacturing method for fuel pellets demonstrated

- 3 min instead of 8 hrs

2019

New Alumina Forming Austenitic (AFA) steel developed, for weld overlays

2020

Patent for lead-cooled reactor design with double lid approved, making it possible to build more compact reactors

New Alumina Forming Martensitic (AFM) steel developed, suitable for pump impellers

2021

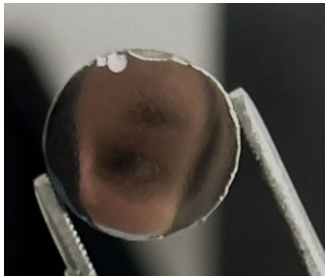
AFA steel fulfill all requirements for weld overlay protection of the reactor vessel

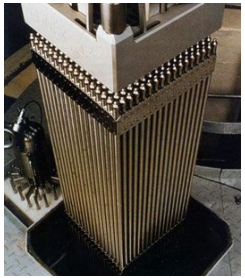
2022

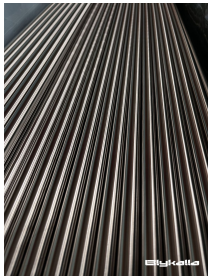
Uranium nitride fuel powder manufactured with inhouse method

2022

Uniper and Norrsken become shareholders







SEALER-One: Sweden's First Advanced Reactor

Item	Value
Power	60 MWt
Lead coolant mass flow	3170 kg/s
Lead inventory	800 tons
Core inlet/outlet temperature	420°C/550°C
Secondary side inlet/outlet temperature	340°C/530°C
Fuel	Uranium Nitride (UN)
Maximum fuel residence time	5000 days
Peak fuel burn-up	18 GWd/ton
Peak damage dose	35 dpa

Traditionally, SMRs are cooled by (light) water, but there is more and more focus on developing so-called advanced designs using other coolants

The benchmark: Water (LWR)

25m

Regulators are comfortable with proven technology.

NUSCALE HITACHI

Advanced designs

Helium

30m

Reactors can reach high temperatures.

energy

Sodium

12m

Superior heat transfer and breeding ratio.

TerraPower

Molten Salt

7m

Simplified fuel cycle.

TERRESTRIAL ENERGY

Lead

5m

Passive safety in most compact form.

Blykalla

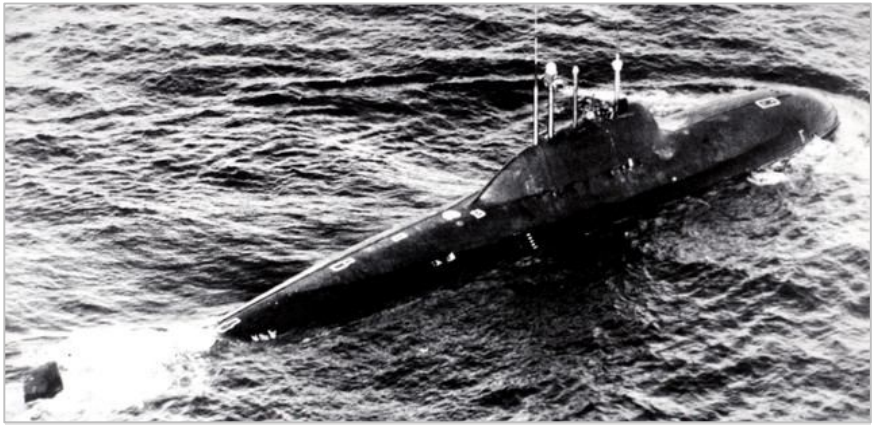
Four competitive advantages over traditional technology

	SMR: light water-cooled	Advanced SMR: lead-cooled
Business case (faster & cheaper)	>7 years, >$100/MWh	<2 years, 40-60% cheaper
Inherent safety enable localization	Up to 50 km planning zone	100s of meters enabling co-location with industry
Industrial use cases	250°C steam - power only	530°C stream - H_2 and biomass heat use cases
Making nuclear sustainable	New uranium mining and 100k years deposits	Reprocessing fuel, fraction of waste stored for <1k years

History of Lead Reactors

Lead-cooling is a proven technology, but it has historically been limited by corrosion

Alfa class submarine, 1968



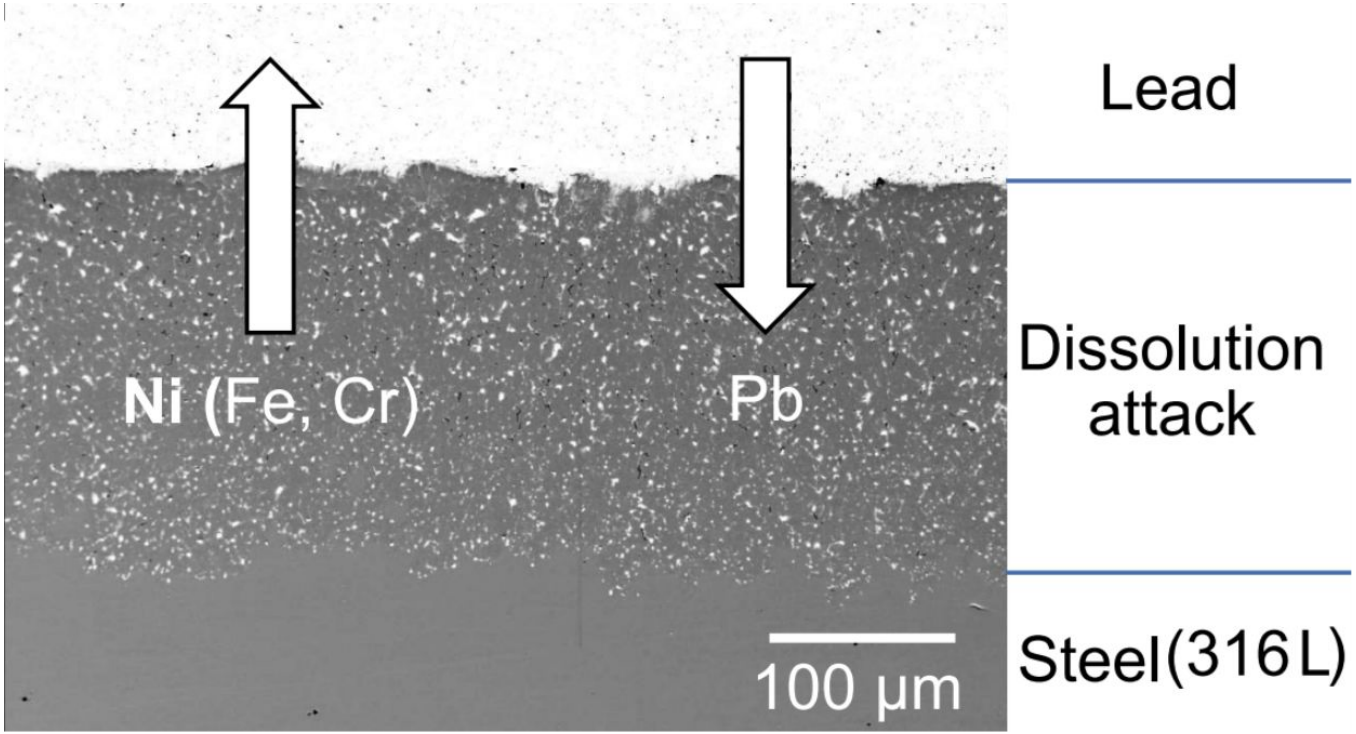
- Lead-cooling with >60 years of history and ~100 reactor years of operational experience
- 11 systems, 9 submarines, 2 on land built by the Soviet, and published data and peer reviewed research on technology
- Developed in European research since 1990s

Regular “stainless steel” (SS316) after being exposed to liquid lead

- Corrosion of materials in liquid lead the historical inhibitor to scaling
- Work-around solutions tried historically include Silicon oxide, but it becomes embrittled, or applying surface treatments, but erosion leads to lead penetrating surface and corroding

History of Lead Reactors

Corrosion has been a main issue for LFR



Stainless steel exposed to liquid lead at 600°C for 1000 hours

Families of AFS - Background

- Ferritic FeCrAl-alloys [Fe-(15-25)Cr-(4-6)Al], was a Swedish invention by Hans von Kantzow, patented 1926.
- Marketed by Kanthal (within the Alleima company) and mainly used in heating elements and wires.
    - Commonly used at high temperatures (900-1300 °C).
- Blykalla has now patented two additional Alumina Forming Steels:
    - Alumina Forming Austenitic (AFA)
    - Alumina Forming Martensitic (AFM)

	FeCrAl	AFA	AFM
Microstructure	Ferritic	Austenitic	Martensitic
IP Owner	Alleima (Kanthal)	Blykalla	Blykalla
Ductility at RT	Brittle (weld)	Ductile	Brittle
Corrosion Protection	Excellent	Good	Excellent
Weld	Difficult	Easy	Not recommended

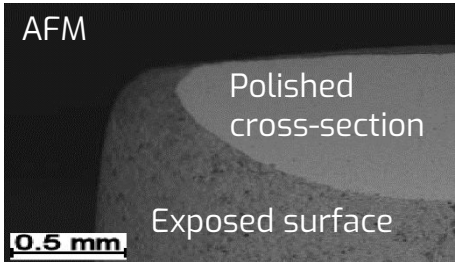
Novel Materials for Corrosion Protection in Lead

FeCrAl - ferrite

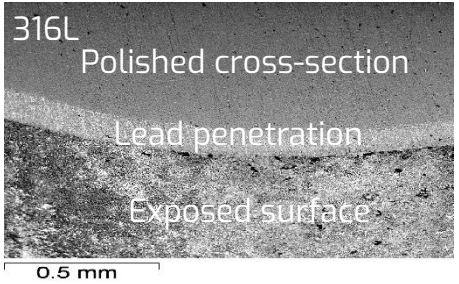
AFA - austenite

AFM - martensite

No weight loss and no visible erosion corrosion in lead.



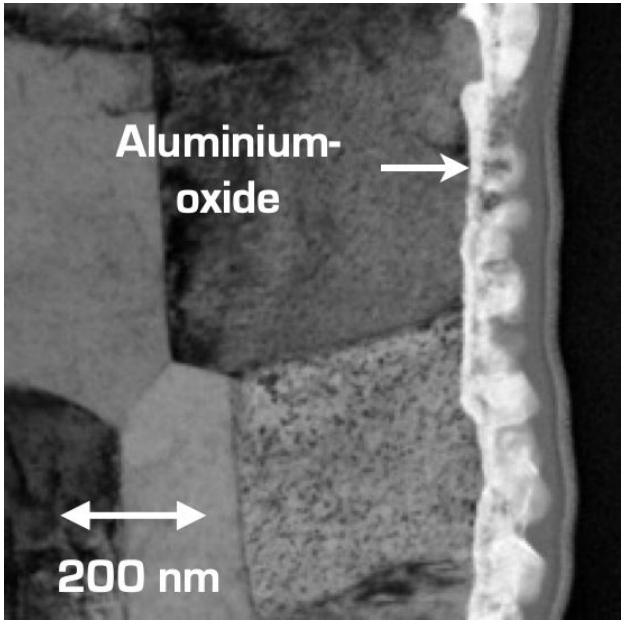
Severe erosion corrosion, weight loss and lead penetration



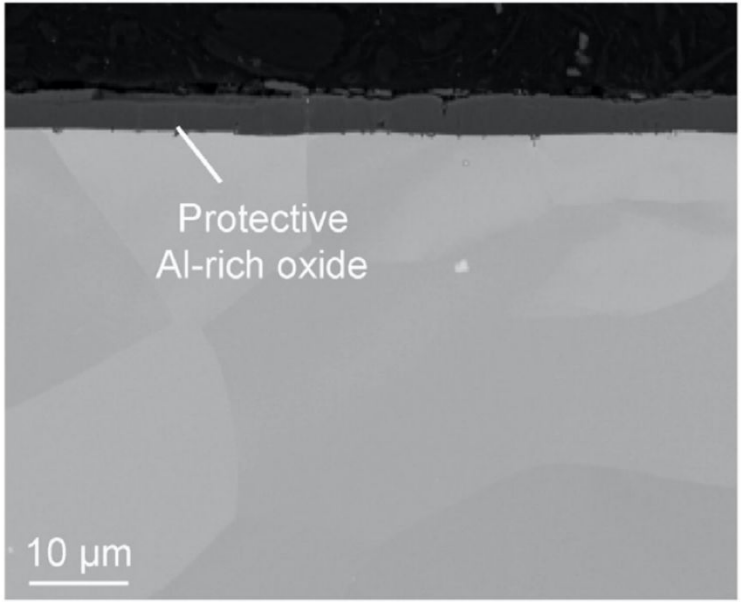
Corrosion protection is achieved through use of novel alumina forming materials as overlay welds on codified pressure boundary materials, and as bulk material for other components.

Corrosion protection at the microscopic scale

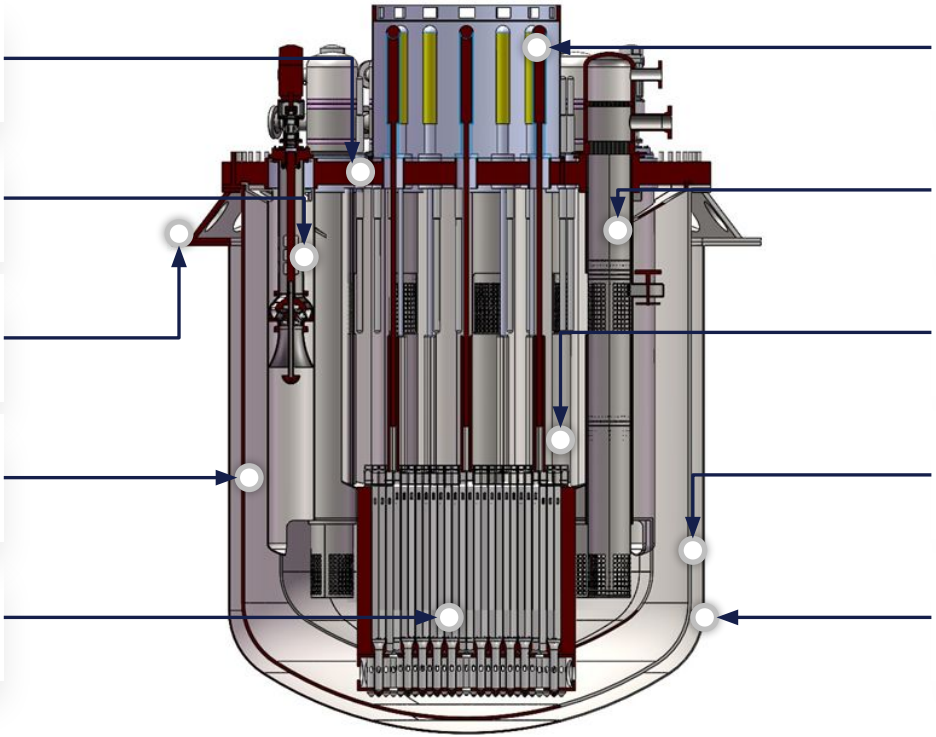
Fe-10Cr-4Al-RE exposed to lead at 550°C for two years



Fe-10Cr-4Al-RE exposed to lead at 800°C for ten weeks



Preliminary Primary System Layout



The Future of Blykalla

Now building test facility and prototype reactor in Oskarshamn with Uniper

On February 3rd 2025 we had our groundbreaking ceremony with the Deputy Prime Minister of Sweden and industrial partners

Our goal is to build 1 000 SMRs. Together they will produce close to 500 TWh of electricity per year.

If successful, we will avoid 0.5 gigatons of CO_2

= 1% of global emissions, every year

(and build a $5 bn company[1])

1 Annual revenues by the end of period, excl fuel

Thank you!