

QUALIFICATION OF STEAM GENERATORS FOR SHIPMENT WITH RESPECT TO THE REQUIREMENTS OF TS-R-1

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- **Radiological Aspects**
- **Packaging Requirements**
- **Tie Down/Lashing**
- **Radiation Protection**
- **Licensing Procedure**
- **Transport**

KWO-Steam Generators



Main Characteristics

Total length	16.58 m
Diameter	3.60 m
Mass	177 Mg

Contamination Limits for SCO-II

Accessible / inaccessible	Fixed / non-fixed	Contamination type	Bq/cm ²
Accessible	non-fixed	$\beta + \gamma + \alpha^1$	400
		α	40
	fixed	$\beta + \gamma + \alpha^1$	8×10^5
		α	8×10^4
Inaccessible	non-fixed + fixed	$\beta + \gamma + \alpha^1$	8×10^5
		α	8×10^4

¹⁾ low toxicity alpha emitters

Nuclide Vector

Nuclide	Co-60	Ni-63	Fe-55	Total Alpha
Proportion [%]	52.6	39.4	7.9	0.1

- **SCO-II - Limit:** 800 kBq/cm²
- **Average contamination:** 120 kBq/cm²
- **Local contamination:** 2700 kBq/cm²

- **Activity:**
3.2 TBq/0.53 TBq
- **Total:** 3.73 TBq < 10 x A₂

10 x A₂ = limit for an inland waterway vessel

Dose Rates

	Limit	Measured
Surface of the Package	2 mSv/h (10mSv/h)	< 1.2 mSv/h
Outer Side of the Vehicle	2 mSv/h	-
2 m Distance	0.1 mSv/h	0.4 mSv/h

Assembling of the Shielding



Support



- **General requirements:**
complied with
- **Dose rate criterion:**
complied with
- **0.3 m drop test:**
not fully complied with

Tie-Down Equipment



Welded Wheel Chocks



Assessed/Measured Doses

	Assessed	Measured
Drivers (road transport)	1.52 mSv	0.08 mSv
Lashing personal	0.9 mSv	0 mSv
Boatsmen	0.3 mSv	0 mSv
Personell for transshipment	0.1 mSv	0.011 mSv

- Minimum distance between the Steam Generator and the Platform of the Trailer shall be 15 mm
 - Road Transport at Walking Speed
 - The River Barge must have Priority over other Ships when passing the Locks
 - Continuous Surveillance of the Radiation Exposure
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Duration of the Project	2 Years
Persons involved	25
Duration of the Voyage	10 Days
Distance (Inland Waterways)	1400 km
Number of Locks	23
Total Weight of the Load	490 to

Cruise on the River Neckar (1)



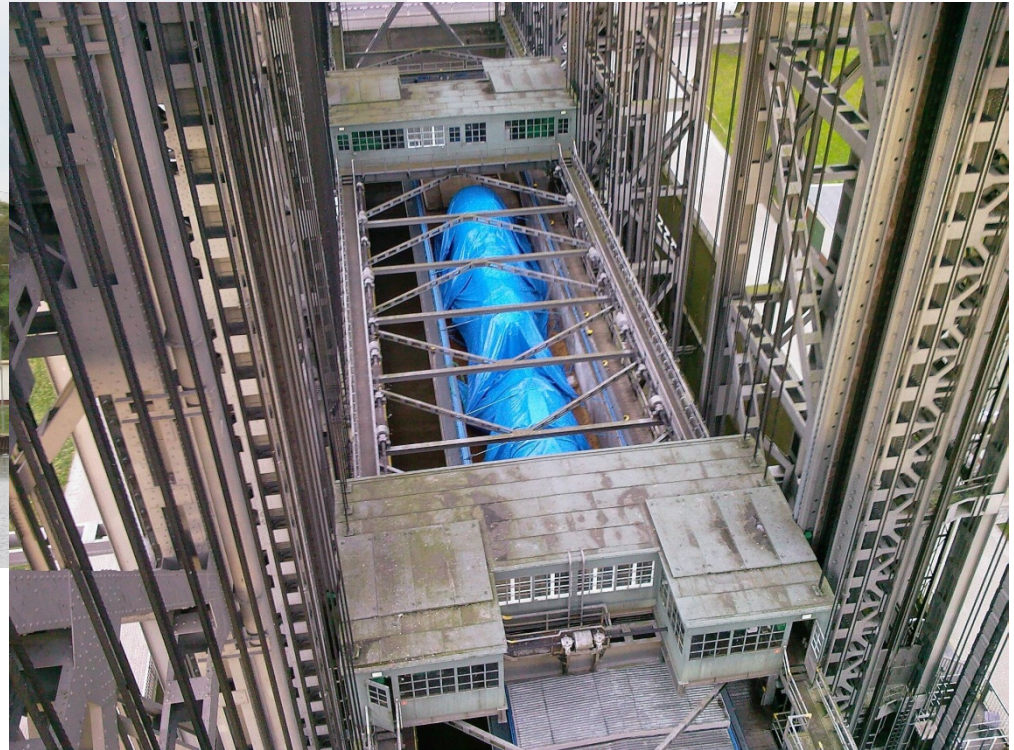
Cruise on the River Neckar (2)



One of the 23 Locks



Shiplift (Elevation Difference: 36 m)



Crossing a Bascule Bridge



Unloading at the Port of Destination

