Doses to Public Arising From the Use of Radioisotopes in Radionuclide Laboratories and Hospitals in Finland

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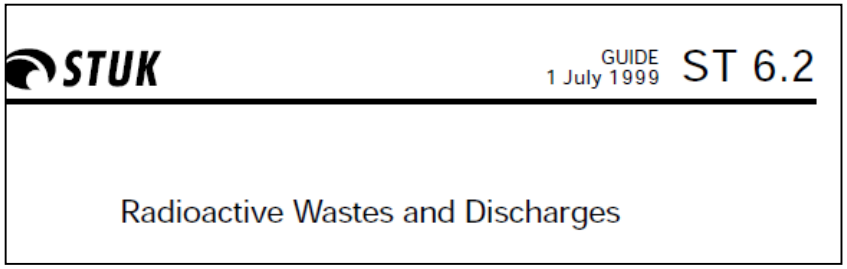
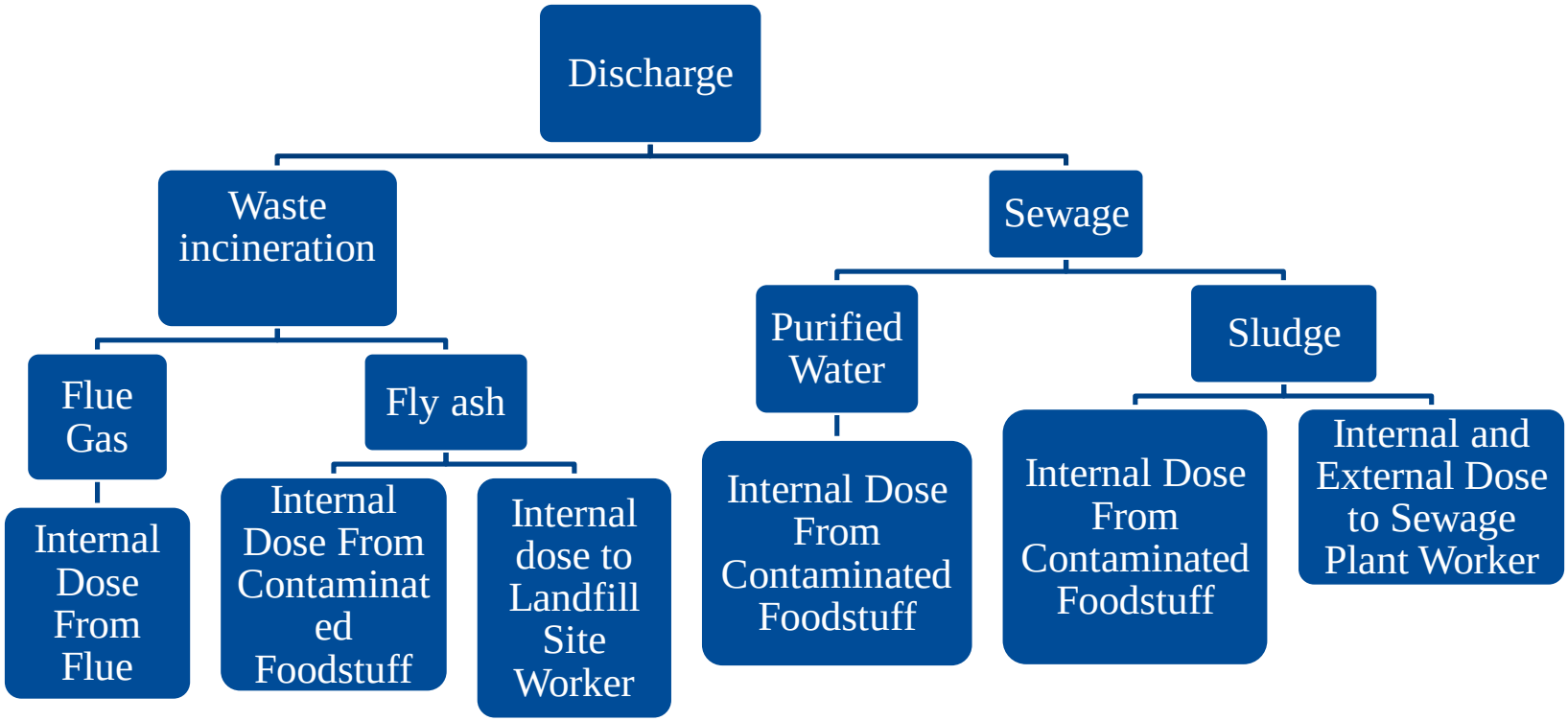
Purpose of the study

- **The regulatory guide ST 6.2” Radioactive wastes and discharges” is set for renewal**



- **The desire to get a ”Bq to Sv” calculation chain**
- **No reason to suspect surrent limits are too high**
- **Estimates for both adults and children**
- **Real disposal activities were used**

Exposure routes considered in the study

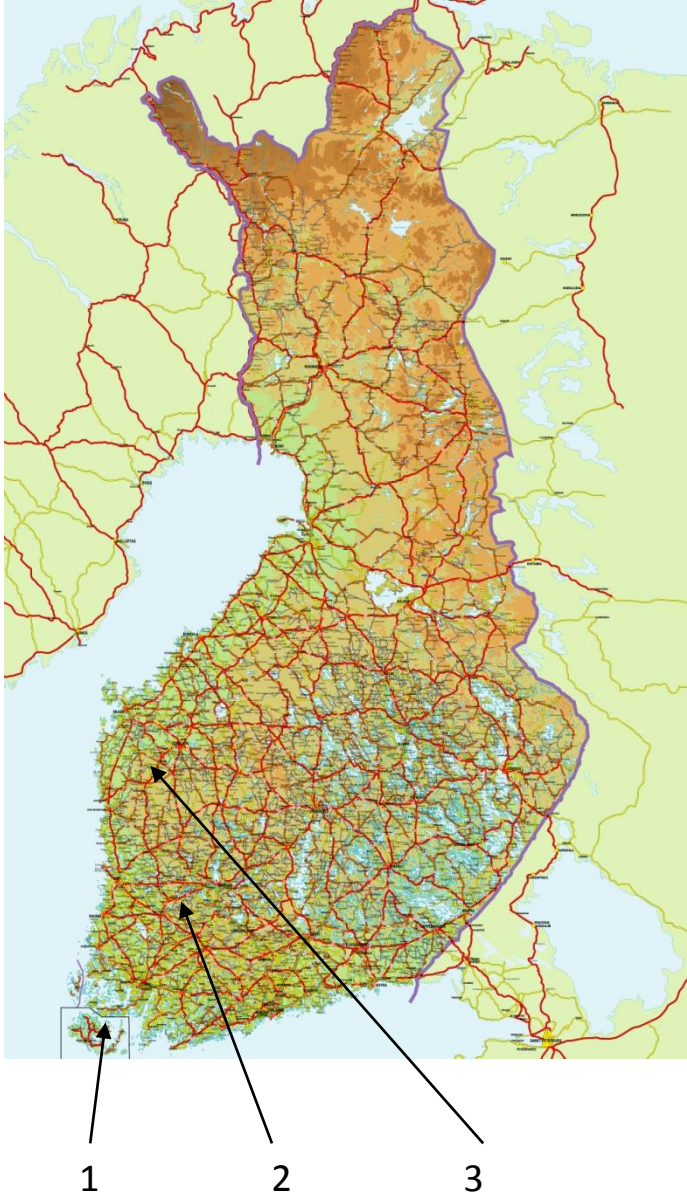


Selected locations

1. **Turku**
   - **Waste incinerator plant**
     - **Flue gas**
     - **Ash deposited at landfill**
2. **Tampere**
   - **Liquid waste from laboratories, hospital**
     - **Purified water pumped to lake Pyhäjärvi**
     - **Sludge used in farming**
3. **Seinäjoki**
   - **Same as Tampere exept cleaned water pumped to river Seinäjoki**

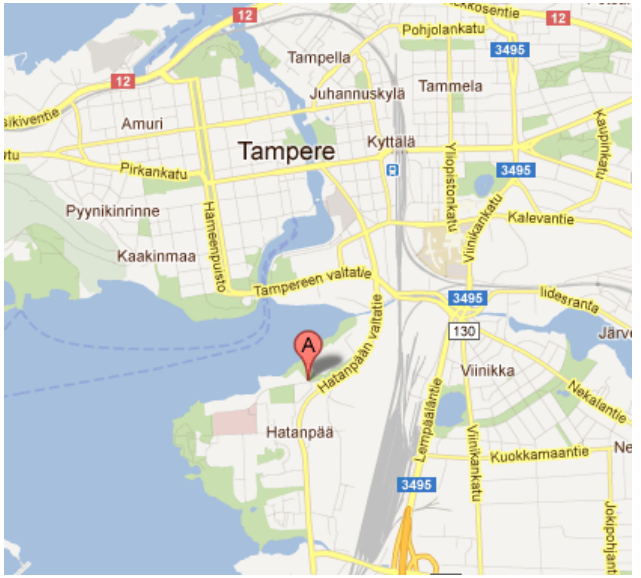
City and site specific data used

- **Stack height, river flow, …**



Example - Tampere

- **Waste from radionuclide laboratory / hospital enters the sewage system**
  - **For hospital discharges, actual reported values for Tampere University Hospital were used**
  - **For laboratories, values for Turku were used**
- **Sewage is treated in the local sewage water treatment plant**
- **Radionuclides are divided between sludge and purified water based on nuclide specificdistribution coefficient**
  - **If a coefficient was found in literature, it was used**
  - **If no coefficient was found, all radionuclides were assumed to go <u>both</u> sludge and purified water -> conservative result**



Example – Tampere, contd.

- **Purified water is pumped into the lake Pyhäjärvi, where it dilutes and is consumed for**
  - **Irrigation -> exposure through consumption of irrigated vegetables**
  - **Fishing -> exposure through consumption of fish**
- **Sludge is used for soil improvement in farming**
  - **Internal and external exposure from soil improvement**
  - **Internal exposure through consumption of**
    - **Meat, milk, grain**
- **Consumption values were taken from literature**
  - **E.g.**

$$C_{crops} = C_{final} \times CF_{crops} \times e^{(-\lambda t_{crops})} \times f_{red}$$

$$E_{crop} = C_{crops} \times IR_{crops} \times DF_{ing}$$

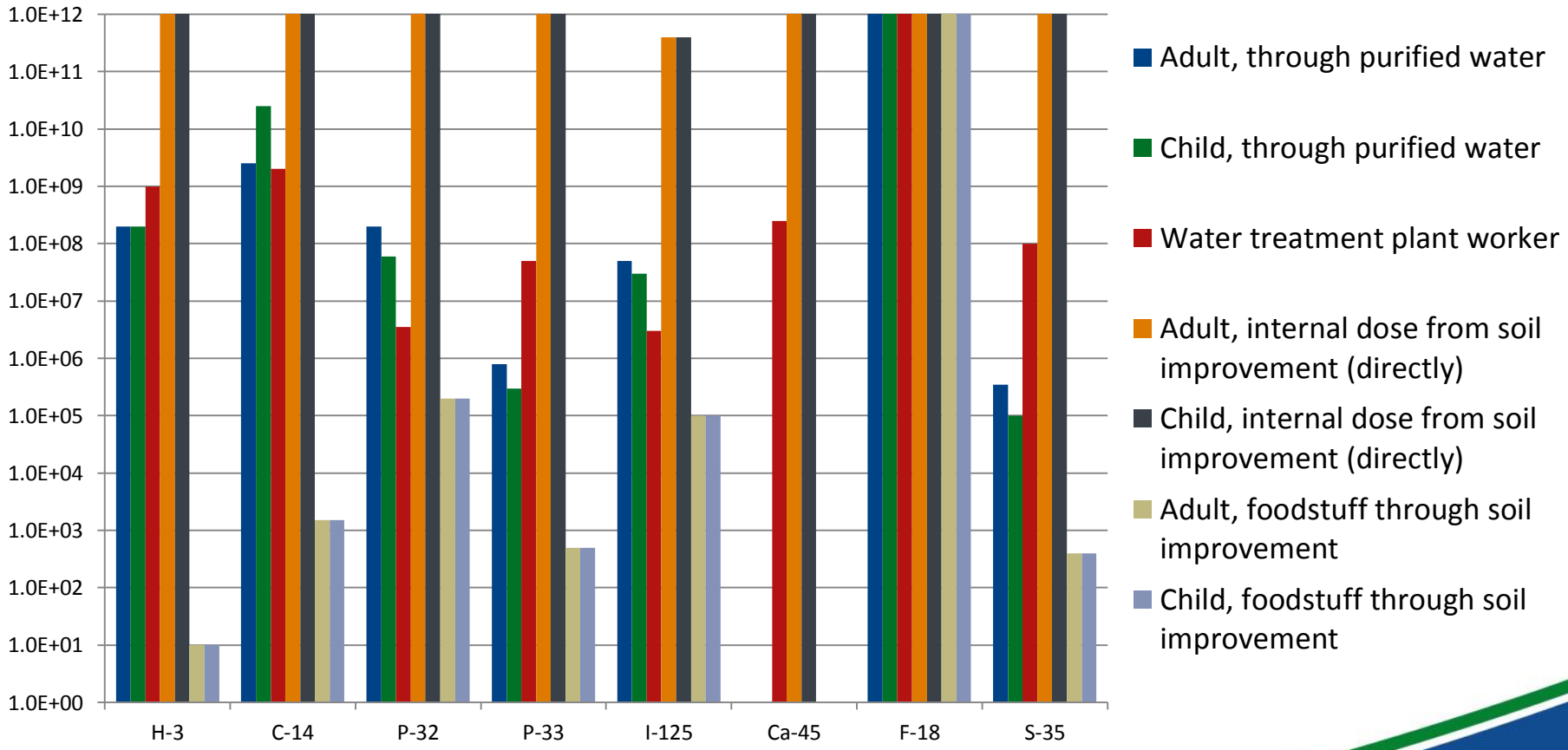
Results – Doses from Tampere University Hospital

Nuclide:	Cr-51	F-18	I-123	I-131	In-111	P-32 (*	Se-75	Tc-99m	Y-90	
Annual Dose, (Sv/a)										**Total Dose: (Sv/a)**
Adult, purified water	1,E-14	7,E-107	1,E-25	4,E-09	2,E-12	5,E-09	5,E-13	6,E-42	3,E-14	**9,E-09**
Child, purified water	4,E-14	2,E-106	4,E-25	1,E-08	4,E-12	1,E-08	9,E-13	1,E-41	9,E-14	**3,E-08**
Sewage tratment plant worker	9,E-10	7,E-20	6,E-08	6,E-06	2,E-07	2,E-07	2,E-10	2,E-07	7,E-08	**7,E-06**
Adult, sludge used as soil improvement	5,E-12	7,E-187	5,E-33	9,E-07	6,E-14	5,E-06	1,E-09	2,E-59	3,E-13	**6,E-06**
Child, sludge used as soil improvement	1,E-11	2,E-186	2,E-32	3,E-06	2,E-13	2,E-05	3,E-09	5,E-59	1,E-12	**2,E-05**

(* P-32: half life of 14 days

Results – Doses from a hypotetical laboratoty in Tampere

The ratio between a discharge that causes a 10 µSv annual dose and the exemption limit of the nuclide



Summary

- A small study was performed to aid in the renewal of the regulatory guide ST 6.2: Radioactive wastes and discharges
- An Excel spreadsheet was developed that can be used in different scenarios for dose estimation
- For laboratory discharges the study confirmed that
  - The current discharge limits do not result in overexposure of the population, as expected
  - The use of nuclide specific exemption levels as a criteria for regulatory limits for annual discharges from radionuclide laboratories is justified
- The results are to be used in the renewal of the guide ST 6.2