EXPERIMENTAL VERIFICATION OF AIR FLOW RATE MEASUREMENT FOR REPRESENTATIVE ISOKINETIC AIR SAMPLING IN VENTILATION STACKS

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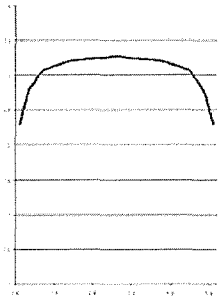
Nuclear facilities are obliged to monitor their discharge's influence on environment. Main monitored factions in NPP's ventilation stacks are usually noble gasses, particulates and iodine. These factions are monitored in air sampled from ventilation stack by means of sampling rosette and bypass followed with on-line measuring monitors and balance sampling devices with laboratory evaluations.
Correct air flow rate measurement and representative isokinetic air sampling system is essential for physical correct and metrological accurate evaluation of discharge influence on environment. Following steps are required:

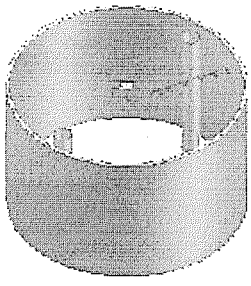
- Determination of flow type (usually turbulent) and main parameters (velocity, pressure, temperature and humidity) distribution in horizontal projection of ventilation stack.
- Experimental verification of theoretical presumption.
- Design proposal of air flow rate measurement.
- Design proposal of representative isokinetic sampling rosette and bypass for noble gases and particulates sampling.
- Design proposal of iodine faction sampling (special requirements).

The type of flowing in ventilation stack is fully developed turbulent flow with the Reynolds number Re≈ 10E+4 what is far enough from the critical Reynolds number Re_{crit}≈ 10E+3. Theoretically proposed velocity distribution was verified with experimental measurement linearly through diameter of stack and example is given on the figure on the right.

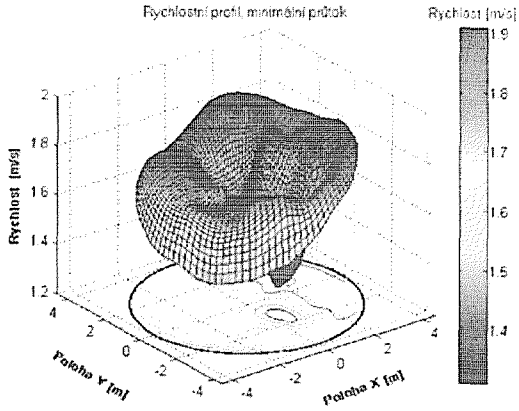


Pairs of measuring sensors (Anemometer, pressure gauge, thermometer and humidity meter) are symmetrically placed in horizontal projection of stack on positions based on measured air flow velocity distribution characteristic. Analogically diameter of sampling rosette nozzles and their placement in the middle of 6-7 annuluses are calculated for assurance of representative isokinetic sampling.

Systematic difference of air flow rate data getting from symmetrically placed measuring sensors was indicated in some ventilation stack.



Decision to measure the air flow velocity distribution in whole horizontal projection of ventilation stack was made. Special experimental rotating arm with 5 anemometers was developed and placed in ventilation stack. Series of 2-D horizontal air velocity distribution measurements with normal, low and minimum total air flow in stack were made.



Resulting air velocity vector field is not fully corresponding with theoretical proposals and is depending on total air flow in stack. An example of velocity distribution is given on the picture. Current result may have influence on hardware and software design changes in the air flow rate an air sampling systems in ventilation stack.

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