BIJLAGE 4 - BREF TOETS

INDUSTRIAL COOLING SYSTEMS

DECEMBER 2001

Itero pilot plant

DATUM VAN UITVOERING:
16-6-2023

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Paragraaf	BAT	Voorschrift uit BREF	Invulling voorschrift
4.2.1.2 BAT general			
	All installations		
	☑	An integrated approach is applied to reduce the environmental impact of industrial cooling systems maintaining the balance between both the direct and indirect impacts (no minimum ratio available)	Enkel gesloten luchtkoelsystemen met warmteterugwinning zijn toegepast
	Greenfield installation		
	NVT	Assessment of the required heat capacity can only be BAT if it is the outcome of maximum use of the internal and external available and applicable options for reuse of excess heat.	
	Existing installation		
	NVT	Optimizing internal and external reuse and reducing the amount and level of heat to be discharged must also precede any change to the potential capacity of the applied cooling system. Increasing the efficiency of an existing cooling system by improving systems operation must be evaluated against an increase of efficiency by technological measures through retrofit or technological change	
4.2.1.3 BAT related to process requirements (Table 4.1)			
	Level of dissipated heat high (> 60ºC)		
	☑	Reduce use of water and chemicals and improve overall energy efficiency: (Pre-) cooling with dry air (Energy efficiency and size of cooling system are limiting factors)	In het ontwerp wordt rekening gehouden met BBT's maar er wordt ook gekeken naar de meest efficiënte oplossing voor het Itero proces. De gekozen oplossing is altijd gelijkwaardig of beter dan de beschreven BBT's
	Level of dissipated heat medium (25-60ºC)		
	☑	Improve overall energy efficiency: No evident BAT, Site-specific	In het ontwerp wordt rekening gehouden met BBT's maar er wordt ook gekeken naar de meest efficiënte oplossing voor het Itero proces. De gekozen oplossing is altijd gelijkwaardig of beter dan de beschreven BBT's
	Level of dissipated heat low (<25ºC)		
	☑	Improve overall energy efficiency Water cooling Site selection	In het ontwerp wordt rekening gehouden met BBT's maar er wordt ook gekeken naar de meest efficiënte oplossing voor het Itero proces. De gekozen oplossing is altijd gelijkwaardig of beter dan de beschreven BBT's
	Low and medium heat level and capacity		
	NVT	Optimum overall energy efficiency with water saving and visible plume reduction: Wet and hybrid cooling system (Dry cooling less suitable due to required space and loss of overall energy efficiency)	Geen open of hybride systemen aanwezig
	Hazardous substances to be cooled involving high environmental risk		
	NVT	Reduction of risk of leakage: Indirect cooling system (Accept an increase in approach)	

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4.4.2 BAT related to site characteristics (Table 4.2)			
	Climate		
	☑	Required design temperature: Assess variation in wet and dry bulb T (With high dry bulb T dry air cooling generally has lower Energy efficiency)	Onderdeel van detail engineering
	Space		
	☑	Restricted surface on-site: (Pre-assembled) Roof type constructions (Limits to size and weight of the cooling system)	Onderdeel van detail engineering
	Surface water availability		
	NVT	Restricted availability :Recirculating systems (Wet, dry or hybrid feasible)	
	Sensitivity of receiving water body for thermal loads		
	☑	Meet capacity to accommodate thermal load: - Optimise level of heat reuse - Use recirculating systems - Site selection (new cooling system)	Onderdeel van detail engineering
	Restricted availability of groundwater		
	NVT	Minimisation of groundwater use: Air cooling if no adequate alternative water source is available (Accept energy penalty)	
	Coastal area		
	NVT	Large capacity > 10 MWth: Once-through systems (Avoid mixing of local thermal plume near intake point, e.g. by deep water extraction below mixing zone using temperature stratification)	
	Specific site requirements		
	NVT	In case of obligation for plume reduction and reduced tower height: Apply hybrid cooling system (Accept energy penalty)	
4.3.2 BAT for increasing overall energy efficiency (Table 4.3)			
	Large cooling capacity (cooling capacity >10 MWth)		
	NVT	Select site for once-through option	
	All systems		
	☑	Apply option for variable operation (identify required cooling range)	Koelsystemen zijn ontworpen om variabel ingezet te kunnen worden afhankelijk van de procesparameters
	☑	Apply modulation of air/water flow	

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	All wet systems		
	NVT	Clean circuit/ exchanger surfaces: Optimised water treatment and pipe surface treatment, requires adequate monitoring	
	Once-through systems		
	NVT	Maintain cooling efficiency: Avoid recirculation of warm water plume in rivers and minimise it in estuaries and on marine sites	
	All cooling towers		
	NVT	Reduce specific energy consumption: Apply pumping heads and fans with reduced energy consumption	
4.4.2 BAT for reduction of water requirements (Table 4.4)			
	All wet cooling systems		
	NVT	Reduction of need for cooling: Optimisation of heat reuse	
	NVT	Reduction of use of limited sources: Use of groundwater is not BAT	
	NVT	Reduction of water use: Apply recirculating systems	
	NVT	Reduction of water use, where obligation for plume reduction and reduced tower height: Apply hybrid cooling system (accept energy penalty)	
	NVT	Where water (make-up water) is not available during (part of) process period or very limited (drought-stricken areas): Apply dry cooling (accept energy penalty)	
	All recirculating wet and wet/dry cooling system		
	☑	Reduction of water use: Optimization of cycles of concentration (Increased demand on conditioning of water, such as use of softened make-up water)	Onderdeel van detail engineering
4.5.2 BAT for reduction of entrainment (Table 4.5)			
	All once-through systems or cooling systems with intakes of surface water		
	NVT	Appropriate position and design of intake and selection of protection technique: Analysis of the biotope in surface water source (also critical areas, such as spawning grounds, migration areas and fish nurseries)	
	NVT	Construction of intake channels: Optimise water velocities in intake channels to limit sedimentation; watch for seasonal occurrence of macrofouling	

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Paragraaf	BAT	Voorschrift uit BREF	Invulling voorschrift
4.6.3.1 BAT for reduction of emissions to water by design and maintenance techniques(Table 4.6)			
	All wet cooling systems		
	NVT	Apply less corrosion-sensitive material: Analysis of corrosiveness of process substance as well as of cooling water to select the right material	
	NVT	Reduction of fouling and corrosion: Design cooling system to avoid stagnant zones	
	Shell&tube heat exchanger		
	NVT	Design to facilitate cleaning: Cooling water flow inside tube and heavy fouling medium on tube side	
	Condensers of power plants		
	NVT	Reduce corrosion sensitiveness: Application of Ti in condensers using seawater or brackish water	
	NVT	Reduce corrosion sensitiveness: Application of low corrosion alloys (Stainless Steel with high pitting index or Copper Nickel)	
	NVT	Mechanical cleaning: Use of automated cleaning systems with foam balls or brushes (in additional mechanical cleaning and high water pressure may be necessary)	
	Condensers and heat exchangers		
	☑	Reduce deposition (fouling) in condensers: Water velocity > 1.8 m/s for new equipment and 1.5 m/s in case of tube bundle retrofit	Onderdeel van detail engineering
	☑	Reduce deposition (fouling) in heat exchangers: Water velocity > 0.8 m/s	Onderdeel van detail engineering
	☑	Avoid clogging: Use debris filters to protect the heat exchangers where clogging is a risk	Onderdeel van detail engineering
	Once-through cooling system		
	NVT	Reduce corrosion sensitiveness: Apply carbon steel in cooling water systems if corrosion allowance can be met	
	NVT	Reduce corrosion sensitiveness: Apply reinforced glass fibre plastics, coated reinforced concrete or coated carbon steel in case of underground conduits	
	NVT	Reduce corrosion sensitiveness: Apply Ti for tubes of shell&tube heat exchanger in highly corrosive environment or high quality stainless steel with similar performance (Ti not in reducing environment, optimised biofouling control may be necessary)	
	Open wet cooling tower		
	NVT	Reduce fouling in salt water condition: Apply fill that is open low fouling with high load support	

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Paragraaf	BAT	Voorschrift uit BREF	Invulling voorschrift
	NVT	Avoid hazardous substances due to anti-fouling treatment: CCA treatment of wooden parts or TBTO containing paints is not BAT	
	Natural draught wet cooling towers		
	NVT	Reduce anti-fouling treatment: Apply fill under consideration of local water quality (e.g. high solid content, scale)	
4.6.3.2 BAT for reduction of emissions to water by optimised cooling water treatment(Table 4.7)			
	All wet systems		
	NVT	Reduce additive application: Reduce additive application	
	NVT	Use of less hazardous chemicals: It is not BAT to use : • chromium compounds • mercury compounds • organometallic compounds (e.g. organotin compounds) • mercaptobenzothiazole • shock treatment with biocidal substances other than chlorine, bromine, ozone and H2O2	
	Once-through cooling system and open wet cooling towers		
	NVT	Target biocide dosage:To monitor macrofouling for optimising biocide dosage	
	Once-through cooling system		
	NVT	Limit application of biocides: With sea water temperature below 10-12ºC no use of biocides	
	NVT	Reduction of FO emission: Use of variation of residence times and water velocities with an associated FO or FRO-level of 0.1 mg/l at the outlet (not applicable for condensors)	
	NVT	Emissions of free (residual) oxidant: FO or FRO ≤ 0.2 mg/l at the outlet for continuous chlorination of sea water(Daily (24h) average value)	
	NVT	Emissions of free (residual) oxidant: FO or FRO ≤ 0.2 mg/l at the outlet for intermittent and shock chlorination of sea water(Daily (24h) average value)	
	NVT	Emissions of free (residual) oxidant: FO or FRO ≤ 0.5 mg/l at the outlet for intermittent and shock chlorination of sea water (Hourly average value within one day used for process control requirements)	
	NVT	Reduce amount of OX-forming compounds in fresh water: Continuous chlorinating in fresh water is not BAT	
	Open wet cooling towers		
	NVT	Reduce amount of hypochlorite: Operate at 7 ≤ pH ≤ 9 of the cooling water	
	NVT	Reduce amount of biocide and reduce blowdown: Application of sidestream biofiltration is BAT	
	NVT	Reduce emission of fast hydrolyzing biocides: Close blowdown temporarily after dosage	

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Paragraaf	BAT	Voorschrift uit BREF	Invulling voorschrift
	NVT	Application of ozone: Treatment levels of ≤ 0.1 mg O3/l (Assessment of total cost against the application of other biocides)	
4.7.2 BAT for reduction of emissions to air (Table 4.8)			
	All wet cooling towers		
	NVT	Avoid plume reaching ground level: Plume emission at sufficient height and with a minimum discharge air velocity at the tower outlet	
	NVT	Avoid plume formation: Application of hybrid technique or other plume suppressing techniques such as reheating of air (Need local assessment (urban areas, traffic))	
	NVT	Use of less hazardous material: Use of asbestos, or wood preserved with CCA (or similar) or TBTO is not BAT	
	NVT	Avoid affecting indoor air quality: Design and positioning of tower outlet to avoid risk of air intake by air conditioning systems (Is expected to be less important for large natural draught CT with considerable height)	
	NVT	Reduction of drift loss: Apply drift eliminators with a loss <0.01% of total recirculating flow (Low resistance to airflow to be maintained)	
4.8.2 BAT for reduction of emissions to air (Table 4.9)			
	Natural draught cooling towers		
	NVT	Reduce noise of cascading water at air inlet: Reduce noise of cascading water at air inlet (associated reduction levels ≥ 5 dB(A))	
	NVT	Reduce noise emission around tower base: emission around tower base E.g application of earth barrier or noise attenuating wall (associated reduction levels <10 dB(A))	
	Mechanical draught cooling towers		
	NVT	Reduction of fan noise: Apply low noise fan with characteristics, e.g.: - larger diameter fans; - Reduced tip speed (≤ 40 m/s)(associated reduction levels <5 dB(A))	
	NVT	Optimised diffuser design: Sufficient height or installation of sound attenuators(associated reduction levels :variable)	
	NVT	Noise reduction: Apply attenuation measures to inlet and outlet (associated reduction levels ≥ 15 dB(A))	
4.9.2 BAT to reduce the risk of leakage (Table 4.10) – not applicable for condensors			
	All heat exchangers		
	☑	Avoid less cracks: ΔT over heat exchanger of ≤ 50ºC (Technical solution for higher ΔT on case-by-case basis)	Onderdeel van detail engineering
	Shell&tube heat exchanger		

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Paragraaf	BAT	Voorschrift uit BREF	Invulling voorschrift
	NVT	Operate within design limits: Monitor process operation	
	NVT	Strength of tube/tube plate construction: Apply welding technology	
	Equipment		
	☑	Reduce corrosion : T of metal on cooling water side < 60ºC (Temp. affects inhibition of corrosion)	Onderdeel van detail engineering
	Once-through cooling system		
	NVT	VCI score of 5-8 Direct system $P_{cooling\ water} > P_{process}$ and monitoring (Immediate measures in case of leakage)	
	NVT	VCI score of 5-8:Direct system $P_{cooling\ water} = P_{process}$ and automatic analytical monitoring (Immediate measures in case of leakage)	
	NVT	VCI score of ≥ 9:Direct system $P_{cooling\ water} > P_{process}$ and automatic analytical monitoring (Immediate measures in case of leakage)	
	NVT	VCI score of ≥ 9 Direct system with heat exchanger of highly anticorrosive material/ automatic analytical monitoring (Automatic measures in case of leakage)	
	NVT	VCI score of ≥ 9: Change technology - indirect cooling - recirculating cooling - air cooling	
	NVT	Cooling of dangerous substances: Always monitoring of cooling water	
	NVT	Apply preventive maintenance: Inspection by means of eddy current (Other nondestructive inspection techniques are available)	
	Recirculating cooling systems		
	NVT	Cooling of dangerous substances: Constant monitoring of blowdown	
4.10.2 BAT to reduce biological growth (Table 4.11)			
	All wet recirculating cooling systems		
	NVT	Reduce algae formation: Reduce light energy reaching the cooling water	
	NVT	Reduce biological growth: Avoid stagnant zones (design) and apply optimized chemical treatment	
	NVT	Cleaning after outbreak: A combination of mechanical and chemical cleaning	
	NVT	Control of pathogens: Periodic monitoring of pathogens in the cooling systems	
	Open wet cooling towers		

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Paragraaf	BAT	Voorschrift uit BREF	Invulling voorschrift
	NVT	Reduce risk of infection: Operators should wear nose and mouth protection (P3-mask) when entering a wet cooling tower (If spraying equipment is on or when high-pressure cleaning)	