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## BENEFITS

- Stay in full control of the LNG cargo
- Save time when calculating and planning different options for where to ship the LNG Cargo
- Ensure that the quality of the LNG cargo will comply with the requirements of the receiving terminal
- Validate the aging of the LNG cargo against expected values for the vessel





### KONGSBERG INFORMATION MANAGEMENT SYSTEM

# K-IMS: LNG Aging

LNG Aging is an application suite available on Kongsberg Maritime's Information Management System (K-IMS).

Operators can analyze and calculate swiftly implications and consequences of different options for LNG transport, e.g. reducing or increasing speed with respect to aging of LNG compositions and Boil off Rate, rerouting vessels to different terminals while ensuring that requirements are met with respect to LNG compositions.

The K-IMS LNG Aging application suite consists of an Online and Offline module.

### **Intuitive and User-Friendly User Interfaces**

The **Online module** includes an **LNG Aging Prediction application** that uses the vessel's live data for showing current and predicted LNG compositions for selected dates. When changing the selected dates, the application will automatically recalculate the LNG aging and compositions. Feature included to select a summary view for all tanks or individual tank view as shown below.



LNG Aging Online: Prediction for Cargo Tank 1

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#### FEATURES

- LNG Aging is easy to install and comes with several user-friendly applications and interfaces
- Integrated solution with live data from vessel for LNG prediction
- Graphs and Trends for operators to easily track LNG Composition development
- Copy and paste functions for LNG Compositions to easily transfer values between applications
- The application follows ISO6976 for Gross Calorific Value calculations and ISO6578 for Density calculations



The **Offline module** includes four applications that are based on user data input. The four applications are: **LNG Aging Validator**, **LNG Mix**, **LNG Volume Correction**, and **LNG Aging Prediction**.

With the LNG Aging Validator application operators can input the loading and unloading LNG cargo data to validate and compare  $N_{2}$ - and  $CH_4$  time constants and Boil-Off-Rate against expectations.

NG Properties Development								Calculation Result		
Parameter	Value	Law	Parameter	Loadrop data 🕸 🗑	University dete 🗟 🗎	Difference	Unit	Fatameter	Value	UNIT
ration of transfer	15	days	Methane	89.8200	85.0000	0.0209	moth	<ul> <li>Time constant Ni</li> </ul>	63.704	cleys
		Ethane	6.3200	6.4200	0.1009	more	Time constant O4	1195.869	days	
Parameter	Value		Propane	2,1600	2.1700	0.0100	moth	CHUTH, TC ratio	38.772	
otal forced vaporizer volume	1	mt.	Heutane	0.0000	0.0000	0.0000	moth	Liquid temp. change	0.000	*C/day
Thermal volumetric coefficient	.0.3	%/°C	n Butani	1.2000	1.2100	0.0100	moth	Volume based BOR	0.094	%/day
		iPennase	0.0000	0.0000	0.0000	math	Oamp. based BOR	0.080	e.day	
	n Pentane		n Pestase	0.0000	8.0000	0.0000	moth-	BOR deviation	-14.748	•
			n Hexane	0.0000	0.0000	0.0000	molts	Validation Limits		
			Nerogen	0.6000	0.4000	-0.1000	moth			
			Oxygen	0.0000	0.0000	0.0000	moth			
			Carbon dioxide	0.0000	0.0000	0.0000	moth	0 20	43 63	80
			Total	100.0000	100.0000	0 0000	moth	TC calls		_
			Vapour pressure	80.0000	94.0000	14 0000	MPA .	0 10	20	30
			Vagiour temperature	100.0000	-917 00000	3,0000	°C		11	
			Observed legisl temperature	-140.0000	-160.0000	0.0000	iτ.	-50		
			Lagual volume at observed temperature	1 000 0000	985.0008	-15.0008	mt			

With the **LNG Mix application** operators can calculate the LNG composition after mixing two portions of LNG cargo e.g. the remaining LNG heel with a new loading of LNG at a terminal.

Reference Temperature			A LNG Properties						
Parameter	Value	Unit	Parameter	Portion 1 🗄 🛢	Portion 2 🗟 🛢	Mood LNG (B)	Unit		
LNG ref. temp.	-160	10	Methane	119 8200	89.7162	89.7577	mol%		
Ref. temp. for calorific value	26	۳	Ethane	6,3200	5.4250	6.4254	mol%		
			Propane	2.1600	2.2290	21960	mai%		
			i-Butane	0.0000	0.0000	0.0000	morts.		
			n-Butane	1.2005	1.2334	1 2200	mol%		
			(-Penzate	0.000	0.0000	0.0000	math		
			n Pentane	0.0000	0.0000	0.0000	morh		
			nillesane	0.0000	0.0000	0.0000	mol%		
			Nitrogen	0.5000	0.3348	0.4909	moth		
			Oxygen	0.0000	0:0000	0.0000	moth		
			Carbon dioxide	0.0000	0.0000	0.0000	mol%		
			Total	100.0000	100.0000	0	mol%		
			Density at reference temperature	459,4474	460.0972	459 8462	kg/m <sup>4</sup>		
			Gross caterific value	\$4,2005	54.3205	54,2727	MJ/kg		
			Observed liquid temperature	-163.00	-158.00	n/#	°C		
			Liquid volume at observed temperature	28 000 000	30 000 000	0/8	10.4		
			Density at observed temperature	463.6456	457.2686		kg/m*		
			Liquid volume at reference temperature	20181.008	29.814.424	40 005 522	104		

LNG Aging Offline: Mix Calculator

With the **LNG Volume Correction application** operators can calculate how the LNG cargo volume and density changes when the cargo temperature changes.

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LNG Composition			Corrections					
Parameter	Value 🗟 🖷	Unit	Parameter	Condition 1	Condition 2	Difference	Unit	
Methane	89.8200	mol%	Observed liquid temperature	-160.00	-199.00	1.00	°C	
Ethane	6.3200	mol%	Thermal volumetric coefficient	0.30	0.31	0.01	%/°C	
Propane	2.1600	mol%	Liquid volume at observed temperature	10500.000	10532.367	0.31 (%)	m <sup>a</sup>	
i-Butane	0.0000	mol%	Density	459.5412	458.1323	-0.31 (%)	kg/m*	
n-Dutane	1.2000	mol%						
i-Pentane	0.0000	mol%						
n-Pentane	0.0000	mol%						
n-Hexane	0.0000	mol%						
Nitrogen	0.5000	mol%						
Oxygen	0.0000	mol%						
Carbon dioxide	0.0000	mol%						
	100.0000	-						

LNG Aging Offline: Volume Correction

With the **LNG Aging Prediction application** operators can calculate how the LNG compositions age and take data-driven decisions on e.g. reshuffling LNG cargo to other terminals while ensuring compliance with quality requirements.



LNG Aging Offline: Prediction

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