

ENVIRONMENTAL TECHNOLOGY VERIFICATION STATEMENT



Technology Name:	Waste Gas Incinerator
Technology Type:	High Efficiency Enclosed Combustion System
Application:	Gaseous Emissions Control – Industrial Processes
Company:	Questor Technology Inc., Calgary, AB, https://questortech.com/
Verification Body:	350Solutions, ISO/IEC 17020:2012 and ISO 14034 Environmental Technology Verification, Certificate Number AI-2619
Lead Verifier:	Bill Chatterton, 350Solutions

VERIFIED PERFORMANCE CLAIMS

Performance data from the waste gas incinerators by Questor Technology was assessed by 350Solutions to verify specific technology performance claims including:

- Combustion efficiency (CE),
- H₂S conversion efficiency,
- Greenhouse gas reductions.

Verified results for three technology performance claims are summarized below.

Questor Technology Verified Performance

Verification Parameters	Applicable Technology (Model(s))	Verified Range of Operation (gas feed MCFD)	Verified Performance
Combustion efficiency	All currently offered (Q50, Q100, Q250, Q500, Q1000, Q3000, Q5000)	5.34 – 4,584	99.99 ±0.02%
H₂S conversion efficiency		2.06 – 679	99.99 ±0.01%
GHG emission reductions		2.06 – 4,584	64 to 90 % GHG reductions ^a

^a Based on IPCC 100-year GWP factors, waste gas venting baseline

TECHNOLOGY DESCRIPTION

Questor’s incinerators are designed to combust hydrocarbon waste gas streams with efficiency greater than 99.99%. The combustors vary in size to accommodate a range of gas flow rates from 50 (Q50 model) to 5,000 (Q5000 Model) thousand cubic feet per day (MCFD). Incinerators designed by Questor are used in multiple segments of the oil and gas industry including upstream, midstream, and downstream processes, in addition to chemical plants and the general waste management industry. The system is particularly suitable for the industry owners and operators who are required to comply with the environmental regulations and guidelines for emissions reduction of hazardous air pollutants, greenhouse gases (i.e. methane) and VOCs. In addition, the system is useful for the industries that are interested to reduce greenhouse gas emissions to generate offset credits. As an example, Air Quality Control Commission, Regulation 7 in Colorado mandates the use of enclosed combustors, and more recently targets methane, resulting in a statewide focus on the responsible management of potentially fugitive hydrocarbons. North Dakota also has additional requirements that reflect some of the unique and specific needs that extend beyond the EPA’s requirements.

Questor combustors have been designed to handle both low- and high-pressure gas streams through a selection of burners which result in the destruction of offensive odors, toxic gases and harmful vapors. The combustors can even draw gases at near-atmospheric pressure, such as dehydrator still columns and tank vapors, and still exceed 99.99% CE. Questor combustors perform within their design across a range of capacities.

Questor combustor specifications

Specifications ^a	Model ^a			
	Q50	Q500	Q3000	Q5000
Typical Capacity (MCFD) ^b	5 - 50	50 - 500	300 - 3000	500 - 5000
Typical height (ft)	25	30	40	40
Exterior diameter (in)	20	48	96	144
Typical weight (lbs)	4,000	14,000	36,000	45,000

^a Specifications are illustrative and show approximate sizing. Actual capacity depends on the type of gas burned and available pressure. Questor custom designs combustors to meet multiple end use applications. Additional models/capacities are available including Q100, Q250, and Q1000 depending on application requirements.

^b Based on natural gas (0.6 kg/m³)

VERIFICATION DESCRIPTION

The primary objective of this assessment was to verify the performance claims made by Questor with respect to operation of the combustor technology in relevant applications. Verification parameters were assessed quantitatively using data generated in appropriate field applications of the technology. Verifiers reviewed technology performance data to determine whether the data met the objectives of the verification process. The result of the verification represents a confirmation of the performance of the technology, achieved under the same conditions, constraints and limitations as those specified for the generation of the data used for verification.

For Performance Claims 1 and 2, the verification addressed technology performance with respect to combustion efficiency (conversion of hydrocarbons to CO₂) and H₂S conversion efficiency (oxidation of hazardous sulfur species). Performance Claim 3 examined GHG emission reductions by calculating the GHG intensity of the inlet (waste) gases and comparing those values to the GHG intensity of corresponding technology exhaust gases. Reductions in GHG intensity were analyzed using two baseline scenarios: venting of waste-gases, and treatment by flaring (using published ranges of efficiencies for

gas flaring in the oil and gas industry), and by examining reductions using both 20- and 100-year IPCC GHG global warming potential (GWP) intensity factors.

In its application for verification, Questor provided significant test data relevant to assess the performance claims. This existing data was the basis for verification and were reviewed in detail following procedures specified in the plan. Verification of the existing performance data indicated that:

- Verified data was generated by third party emissions testing contractors outside of Questor management;
- Testing was conducted following standardized reference methods published by EPA or Canadian regulatory bodies;
- Testing was conducted at a variety of oil and gas facilities and other processing plants;
- Tests were generally conducted to demonstrate regulatory compliance under stable and representative process operations.

VERIFICATION OF PERFORMANCE

The Questor system design is reported to be consistent across the range of model capacities and therefore, the performance claims span the operational range and technology models offered by Questor. The verification assessed consistency across this capacity range to the extent that existing testing data provided in the verification application supported the claims.

Verified results for three technology performance claims are summarized below. The results are presented as a function of verification boundaries (process operations, unit capacity), verified test results, and key verification findings. For CE and H₂S conversion, efficiencies were at or above 99.99% for all test examined, and measured concentration of hydrocarbons and H₂S were at or near method detection limits.

Questor Technology - Verified Combustion and H₂S Conversion Efficiency

Verification Parameters	Applicable Technology (Model(s))	Verification Operating Range (gas feed MCFD)	Verified Performance
Combustion efficiency (CE)	Q50, Q100, Q250, Q500, Q1000, Q3000, Q5000	5.28 – 4,584	99.99 ±0.01%, (99% confidence interval)
H ₂ S conversion efficiency		2.06 – 679	99.99 ±0.02%, (95% confidence interval)

Questor Technology - Verified GHG Reduction Estimations

Verification Parameter	Baseline Scenario	Applicable Technology (Model(s))	20-year GWP	100-year GWP
Incinerator GHG reductions	Waste gas venting (no controls)	Q50, Q100, Q250, Q500, Q1000, Q3000, Q5000	83 – 96%	64 – 90%
	Conventional flare (80% efficiency)		43-72%	23-63%

For GHG emissions reduction, incinerator's performance is compared with two baseline scenarios of venting and flaring. Considering the GWP 20 of the GHGs, incineration provides 83 to 96% higher emissions reduction efficiency compared to a venting (or no treatment) scenario. When incineration is compared to flaring, efficiency in GHG reduction is 43 – 72% higher, depending on the waste gas composition and flow rate. At the 100-year GWP, incineration is 64-90% more efficient than venting and

23-63% more efficient than flaring. A higher flow rate of waste gas results in a higher percentage of GHG emissions reduction.

Results of the verified GHG reductions can be used by potential users of the technology to estimate facility carbon footprint reductions and regional potential carbon tax reductions.

DATA QUALITY

350Solutions, an ANAB accredited ISO/IEC 17020:2012 inspection body for ISO 14034 ETV, was contracted by Questor to provide independent verification of performance of their clean combustion thermal oxidizer (or incinerator) technology. The verification process applied was based on 350Solutions' Standard Operating Procedure QSP-350-223-01: "ISO 14034 Environmental Technology Verification", the ISO Technical Committee 207 draft guidance document "*Environmental technology verification — E.T.V — Guidance to implement ISO 14034*", and a technology specific Verification Plan. The objectives and approaches used for this verification were designed to apply these principles and processes to Questor's application for verification and performance claims. The verification was approached without consideration to how the technology may apply to any specific regulatory requirements, but rather to provide verified performance results based on a series of real world and relevant technology applications.

In broad terms, the existing data provided by Questor to verify performance with respect to the performance claims were found to be acceptable for verification, with few findings of incompleteness or insufficiency that may present moderate or minimal impact on verification of results, as detailed in the full verification report. Following ISO 14034 guidance, the data quality assessment included:

- Data quality assessment for the specified performance claims;
- Assessment of ancillary data quality (operations, relevance, representativeness);
- Performer competence (testing and analytical providers);
- Sampling and analytical procedures (repeatability, accuracy, measurement equipment calibration and quality checks);
- Data management and processing.

All data reviewed for this verification was categorized as existing test data. In conformance with ISO 14034 requirements, test data provided by the applicant that were generated prior to verification were acceptable for the verification by meeting the following requirements:

- Relevance to the performance claims;
- Were produced and reported according to the requirements of ISO/IEC 17025;
- Met the requirements specified in the verification plan.

Detailed results of the verification are presented in the Final Report titled *Environmental Technology Verification Report – Questor Technology, Inc.* (350Solutions 2020). The report can be made available to the interested parties upon request to Questor Technology.



CEO
350Solutions

President and CEO
Questor Technology Inc.

Notice: ETV verifications conducted by 350Solutions are based on an evaluation of technology performance under specific, predetermined criteria and the appropriate quality assurance procedures. 350Solutions makes no expressed or implied warranties as to the performance of the technology and does not certify that a technology will always operate at the levels verified. The end user is solely responsible for complying with any and all applicable Federal, State, and Local requirements

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