

COOPERATIVE
RESEARCH

About GPA Midstream Industry Research

Although GPA Midstream research dates back to the association's beginnings in the 1920s, the current formal research program was developed in the early 1960s to meet the technological needs of a rapidly expanding industry. Structured early on as a cooperative effort, it is primarily GPA Midstream's members who fund the research program, but other interested parties also contribute. As a result of its successes and benefits to the global midstream industry, the GPA Midstream cooperative research program has received worldwide recognition and is often used as an example for other cooperative programs.

For GPA Midstream members, the cooperative approach has proved to be especially practical, economical, and efficient because it eliminates the needless duplication of individual company research. Furthermore, history has shown that GPA Midstream research projects have stimulated additional research by other organizations and companies, so that total benefits accruing to the industry go substantially beyond the results obtained from just the association's efforts.

GPA Midstream has had an outstanding history of anticipating and determining the most pressing needs of this industry. For more than 50 years, a vast amount of data has been collected from GPA Midstream-led research efforts, leading to greatly improved predictive models for all to use. Today, the GPA Midstream research program continues to serve as a highly effective and efficient means of:

- Identifying and assigning priorities to the industry's data needs.
- Auditing, compiling and evaluating available data and computational methods.
- Designing and supervising experimental measurements of thermodynamic properties on a systematic basis.
- Providing the computational tools for accurate and economical design of light hydrocarbon processing facilities.

The practical achievements of the GPA Midstream research program are evident in the list of published results "GPA Midstream Research Reports" included in this brochure. Examination of this list reveals a wide range of research investigation into virtually every area of gas treating and processing. These data form the basis of most process simulators used in the gas processing industry.

The midstream industry is experiencing technological advancements at a record pace. The GPA Midstream cooperative research program is one way for all GPA Midstream members to be on the leading edge. Thank you for your continued support of GPA Midstream and our research efforts.



All GPA Midstream members contribute to the research program through their annual dues, and some GPSA companies also support the program on a voluntary basis. We greatly appreciate your contributions to the program that truly benefits the entire industry.

THANK YOU 2019 GPA Midstream Research Program Supporters!

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EagleClaw Midstream	Mustang Gas Products	WTG Gas Processing

HOW COOPERATIVE RESEARCH PROJECTS ARE DEVELOPED

The selection of projects presented and administered by GPA Midstream is directly attributable to the members of the two Research Committee sub-groups who oversee the process and the projects. These committee members are highly knowledgeable of the problems faced by this industry on a day-to-day basis, and they know the availability of, or lack thereof, data necessary for the resolution of the key issues. It is such in-depth knowledge — both theoretical and practical — of data and processes that make them proficient in the guidance and evaluation of this research effort.

In addition to the individual knowledge that each member brings, the collective synergy from the groups results in excellent supervision and assessment of the new and continuing research, ensuring that GPA Midstream member companies receive the maximum benefit in return for their funding contributions.

All GPA Midstream research effort is guided by a number of common sense principles:

- Research must concentrate on areas of critical importance to the midstream industry.
- Research must be directed toward problems where solutions are considered possible.
- The economic value to the industry must be evaluated in advance.
- Projects must avoid areas of a proprietary nature or where patents would create problems.

FUNDING LEVERAGE

Of great importance, but often overlooked, is the added value gained through associated relationships beneficial to the GPA Midstream cooperative research program. The funds appropriated by GPA Midstream members get further multiplied as a result of co-funding from other organizations, through partial subsidization by the research contractors and by the extension of GPA Midstream research efforts by other parties with similar vested interests.

Included among those who provide such assistance are:

Propane Education & Research Council (PERC)

GPSA



KARL GERDES
RESEARCH COMMITTEE CHAIRMAN

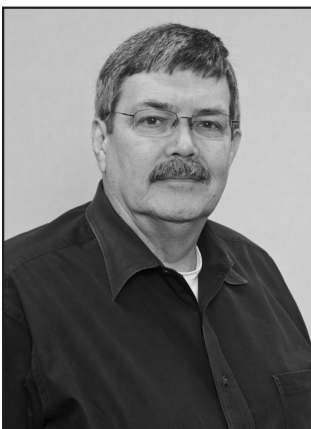
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- Brett Eldred, Targa Resources, Houston, Texas
- Dr. Oliver Koch, Linde Engineering, Pullach, Germany
- Jeff Hammond, ONEOK Partners, Tulsa, Oklahoma
- Steve Hummel, Anadarko Petroleum, Denver, Colorado



CHRIS ROOT
SUB-GROUP #2 CHAIRMAN

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2020 RESEARCH BUDGET

The **2020** GPA Midstream member portion of the research budget is \$300,000 of an overall research budget of \$650,000. Full details follow, along with a description of each research project. The GPA Midstream Board of Directors unanimously approved the budget at its December 2019 meeting.

For **2020**, GPA Midstream has directed \$50,000 from GPSA members' commitments and research reserve funds to the overall budget to help reduce the funding obligation of member companies. GPA Midstream has also directed \$300,000 of funding from PERC to supplement the overall budget. This PERC support is greatly appreciated and will be a great help in continuing GPA Midstream's efforts to provide valuable process data to the light hydrocarbons industry.

BUDGET OVERVIEW			
	GPA Midstream Member Contributions	GPSA Member Contributions PERC Support	TOTAL
Continuing Projects			
191 - Organic Sulfur Distribution in Fractionation Systems	\$55,000	\$65,000	\$120,000
192 - Mutual Solubility Data in NGL Treating	\$55,000	\$65,000	\$120,000
New Projects			
201 - Solubility of Light Hydrocarbons in Amine Treating Solutions	\$55,000	\$65,000	\$120,000
202 - State of the Art Survey for Methanol Removal from Natural Gas, NGLs, and Natural Gas Condensate	\$55,000	\$65,000	\$120,000
203 - NGL Color: Source, Analysis and Removal	\$55,000	\$65,000	\$120,000
204 - Analysis Committee Precision Data Round Robin Project	\$10,000	\$25,000	\$50,000
Total 2020 Budget	\$300,000	\$350,000	\$650,000

NEW PROJECTS

Project 201

Solubility of Light Hydrocarbons in Amine Treating Solutions

Objective: To extend the solubility measurements of hydrocarbons (focusing on paraffin hydrocarbons) in amine solutions to include the effects of acid gas loadings. The data will be used to estimate emissions from amine units (flash gas and regeneration still acid gas streams) and to estimate hydrocarbon carryover into downstream sulfur processing facilities.

Background: This project is a continuation of several previous GPA Midstream projects which measured the solubility of hydrocarbons in loaded and unloaded amine solutions.

This project topic was initiated by Project 971 (RR-180), which quantified the solubility of aromatics (benzene, toluene, ethylbenzene, and xylenes), in unloaded amine solutions. This research work was extended by:

- Project 011 (RR-185) – measurement of the solubility (LLE) of a series of paraffins: n-hexane, 2,2,4-trimethylpentane and cyclohexane in unloaded MEA, DEA, MDEA and DGA, with limited loaded and VLLE data
- Project 021 (RR-195) – measurement of the solubility (VLE and VLLE) of a series of common NGL components (ethane through hexane) in unloaded DEA and MDEA
- Project 975-5 (RR-206) – correlation of data reported in RR-180, RR-185 and TP-29
- Project 071 (RR-220) – measurement of the solubility of heavy hydrocarbons (benzene, toluene, cyclohexane, ethylbenzene, and 2,2,4-trimethylpentane) in MDEA and DGA, loaded and unloaded solutions
- Project 141 (RR-242) – extended these measurements to quantify the influence of acid gas loadings (CO₂) on the solubility of these heavy hydrocarbons: benzene, toluene, ethylbenzene, xylenes, n-hexane, 2,2,4-trimethylpentane and cyclohexane.

The current project will focus on the same amines previously studied (included MDEA, DGA, DEA and MEA), as well as measure the influence of CO₂ (unloaded and loaded amines). The exact data matrix will be determined based on review of the previously completed and ongoing projects, but is expected to contain binary systems containing methane, ethane, propane, n-butane, n-pentane. VLE data will be considered. A future project is needed to understand the impact of mixed acid gas loading (addition of H₂S) on HC VLE.

Value to Industry: Accurate hydrocarbon solubility data will be used to develop new equation of state models that can be applied to the simulation of amine units. The models will be used to optimize the design and operation of amine units in which these hydrocarbons are present in the feed gas. The data provide a basis for accurately predicting the distribution of the hydrocarbons between the treated gas, the amine flash gas, and the acid gas streams – thereby improving the accuracy of estimated emissions of these hydrocarbons from the amine unit and aiding in the design and operation of these units.

Estimated Duration: 2 Years
2020 Budget: \$125,000
Future Costs: \$125,000
Project Coordinator: Mike Hegarty, H2W United

Project 202: State of Art Survey for Methanol Removal from Natural Gas, NGLs, and Natural Gas Condensate

Objective: The purpose of this study is to develop a compilation of current commercially available process technologies capable of removing a portion of or virtually all methanol (MeOH) in various process streams encountered in the natural gas industry, i.e. natural gas, natural gas liquids (NGLs) and/or natural gas condensate streams. The results of the study should allow for side-by-side comparison of the different alternatives and enable process engineers and designers to make choices of technologies based upon a specific set of process conditions.

Background: To avoid the formation of hydrates in natural gas gathering systems where liquid water may be present, operators often inject significant quantities of MeOH into the pipelines. In the past, minimal attention was paid to the amounts of MeOH used and overuse was a common occurrence because operators wished to avoid hydrate formation at all costs. Further complicating the quantification of the problem is that MeOH can be added at several different points throughout the gathering system, and the amount of MeOH coming into a facility may not be routinely known.

A portion of the injected MeOH ultimately ends up in the natural gas and condensate feed streams to the gas processing plant. MeOH will be present in all three phases coming into a gas processing facility – vapor, light liquids and heavy (aqueous) phases. This wide distribution can complicate the selection of treatment options to remove MeOH. If not removed from the natural gas stream during treating, MeOH typically follows propane through the fractionation train and ends up in the NGL streams recovered from refrigeration and turboexpander recovery processes. Oftentimes, the amount of methanol in the recovered products can exceed product specification limits. Multiple tower fractionation configurations or refluxed tower installations used in condensate stabilization may cause excessive methanol concentration in the liquid products generated in the facility if MeOH is not further removed. In the gathering areas, MeOH may be removed during dehydration or sweetening processes which typically result in some form of a MeOH-rich waste stream that may require treatment, since there is potential regulatory concern over MeOH emissions from field equipment, such as glycol dehydration regenerators.

Value to Industry: Information from this survey project is expected to provide process engineers and designers with a detailed enough description of what process technologies currently exist which will remove or mitigate MeOH from the various hydrocarbon product streams found in the oil and gas industries. The survey will provide process design and economic information for determining what technology is most appropriate for removing MeOH from gas and liquid streams at certain process conditions to meet product specifications.

Estimated Duration: 1 Year
2020 Budget: \$125,000
Project Coordinator: Eric Hixson, Williams

Project 203: NGL Color: Source, Analysis and Removal

Objective: The objective of this project is to improve the understanding of the issue of color in NGL streams with a view toward allowing prediction of potential color problems in products, as well as treatment of affected streams to remove it. The scope includes:

- Characterization of the various sources that contribute to color by thorough analysis of off-color samples contributed by member companies.
- Compilation of commercially available measurement techniques and equipment to assist member companies with selection of appropriate means to track product color in the field.
- A survey and technical description of mitigation technologies with recommendations regarding their appropriate use as a practical tool for member companies to select treatment and design options.

Background: NGLs serve as important energy and feedstock resources, adding significant value to gas processing facilities. Several factors can influence the quality of the liquids that are produced, such as acid gas content, water and hydrocarbon composition. One factor that is often encountered yet seldom discussed from a technical perspective is color. Color can result from a variety of contributing sources, including corrosion products or high molecular weight hydrocarbon contamination. The objective of this project is to help affected member companies in their understanding of the issue and determination of needed equipment for analysis and control of components contributing to color problems in NGLs.

Value to Industry: The Midstream Industry will benefit from the product of this project by minimizing problems with off-spec products due to unforeseen color issues. Operators should gain a better understanding of the origin and mitigation of contaminants that cause color problems.

Estimated Duration: 2 Years
2020 Budget: \$125,000
Future Costs: \$125,000
Project Coordinator: Al Goethe, Enterprise Products Operating

Project 204

Analysis Committee Precision Data Round Robin Project

Objective: The purpose of this project is to expand precision guidelines for two existing GPA Midstream analytical standards. The standards are:

- GPA 2198 – Selection, Preparation, Validation, Care and Storage of Natural Gas and Natural Gas Liquids Reference Standard Blends
- GPA 2174 – Obtaining Liquid Hydrocarbons Samples for Analysis by Gas Chromatography

Background: Round-robin testing has been utilized by GPA Midstream for the production of data used for the development of precision statements for certain analytical standards. The GPA Midstream Analysis Committee workgroup has identified the need for precision guidelines that would enable manufacturers to assign per component uncertainties to certified reference blends, as well as laboratories to bound analytical results with analysis uncertainties per component (GPA 2198). The committee also identified a need for a precision guideline covering spot sampling, composite sampling and continuous (online GC) sampling regarding GPA 2174.

Value to Industry: The Precision Statements in analytical methods allow the users of analytical data to understand the accuracy of the data. Understanding the accuracy of these data can help define expectations related to overall product measurement and uncertainty associated with the analytical data. Reasonability assessments of the data require defined precision parameters. Since the analytical data provided by these methods define both quantity and quality of products analyzed, the financial ramifications are directly related to the analytical accuracy.

Estimated Duration: 2 Years
2020 Budget: \$50,000
Future Costs: \$50,000
Project Coordinator: Analysis, Test Methods & Product Specifications Committee

CONTINUING RESEARCH

Project 191

Organic Sulfur Distribution in Fractionation System

Objective: To gain a better understanding of the distribution of organic sulfur compounds that are found in the products of fractionation systems. The study will attempt to determine the reason vapor-liquid equilibria predictions from equation of state simulations that match experimental data do not always translate to accurate matches of plant operation. In particular, the study will determine if significant decomposition of these compounds occurs at the temperatures and pressures commonly encountered in fractionation units. If decomposition is present, an effort will be made to determine the decomposition products, approximate rate of reaction, and mechanism through laboratory experiments.

Background: Trace amounts of organic sulfur compounds (e.g., mercaptans and sulfides) are frequently found in natural gas. Most of these compounds are not removed using standard amine treating systems. Thus, these compounds frequently are found in feed to hydrocarbon fractionation trains.

Past GPA Midstream projects (876 and 986 - published as RR-162 and RR-170 respectively) have focused on the measurement of vapor-liquid equilibrium data of these sulfur compounds in various hydrocarbons. However, models that predict these data accurately may not predict plant performance accurately. Frequently, comparisons of the limited plant data with simulations that match the VLE data are inconclusive in the accuracy of the predictions. Acquiring accurate plant data on these systems is difficult. The concentration of the sulfur compounds in the streams is usually small. This fact and other issues that are normally present in acquiring plant data must be overcome. Most of the plant data used in these comparisons are significantly out of material balance, especially with regard to the organic sulfur compounds and hydrogen sulfide.

This fact has led some to believe that decomposition of these compounds may be significant in these facilities. This could help account for the material balance errors that are observed. Thus, a determination of whether or not this decomposition is occurring is needed. If decomposition is occurring at the conditions of these systems, identification of the decomposition products, the rate of decomposition, and its mechanism will be needed to develop models that can be used to accurately predict distribution of sulfur in the products from these units. If no decomposition is observed at these conditions, the plant data are likely in error and the simulation results can likely be trusted if they match VLE data, and the facility is properly modeled.

Value to Industry: The knowledge of the distribution of sulfur compounds in the products of a fractionation train is critical as units are normally required to remove these compounds to very low levels from the products either due to downstream processing or environmental restrictions. Without a full understanding of the distribution and composition, the location, selection, and size of these units cannot be optimized. An understanding of the VLE in these systems may not be sufficient to predict their distribution. If decomposition is occurring, a knowledge of the products of decomposition, rate of decomposition, and mechanism will also be required.

Estimated Duration: 2 Years

2020 Budget: \$120,000

Investigator: ARMINES

Project Coordinators: Mike Hlavinka, Bryan Research & Engineering
Scott Northrop, ExxonMobil

Project 192

Solids Formation in LPG with Methanol

Objective: The intent of this project is to fill the gaps in collected data by measuring VL(S)E and/or VLL(S)E of LPG-Water-Methanol mixtures, saturated and/or sub-saturated with water, and solids formation data in the presence of methanol, both at high pressure storage conditions and low pressure, low temperature conditions simulating that seen by a typical end user. Data will include binaries for typical hydrocarbons found in LPG mixtures (e.g. ethane, propane, butane) and multi-component LPG mixtures.

Background: A number of previous GPA Midstream projects have measured phase equilibrium data in the propane-water and propane-methanol-water systems. More specifically:

- Project 085 (RR-223) measured data to define the relationship between water content in LPG and the ASTM Freeze Valve test. This project found that even LPG sub-saturated with water at storage conditions may not pass the Freeze Valve Test. Many LPG marketers inject methanol to mitigate freezing concerns, but no tests were run in the presence of methanol.
- Project 084 (RR-231) measured data to define the VLE relationship of LPG-Water-Methanol mixtures. All of the measurements in this project were made for LPG mixtures saturated with water.

- Project 172 (ongoing) is measuring VLE and solids formation data at water sub-saturated conditions in the propane-water-methanol system, but limited the scope to only measuring propane and n-butane and mixtures of the two. Due to budget limitations, Project 172 excluded single hydrocarbon mixtures with ethane, isobutane, and propylene and also commercial propane mixtures (e.g. ethane, propane, propylene blends).
- Additionally, during project 084.2 (ongoing), correlation of the VLLE data measured from Project 084, some data is thought to be suspect, and there are areas where additional data would improve ability to correlate the data. Additional measurements and re-measurement for validation may be appropriate.

This project will focus on data measurement in the following areas: a) filling in gaps from Project 084, b) completing much of the data excluded from Project 172, and c) with solids formation being a key focus, additional data at lower temperatures, particularly with solids/hydrates present (VLSE / VLLSE), will be valuable and improve the ability to correlate the phase equilibrium of this system. The exact data matrix will be determined based on review of the ongoing projects, the approved budget, and to maximize value gained by this project in ultimately correlating the phase equilibrium behavior of the system.

Value to Industry: Improved data quality increases confidence in simulator predictions which, in turn, translates to reduced design margins, saved costs and reduction in methanol consumption.

Estimated Duration: *2 Years*

2020 Budget: *\$120,000*

Investigator: *Colorado School of Mines*

Project Coordinators: *Mahmood Moshfeghian, Petroskills/John M. Campbell
Steve Hummell, Anadarko Petroleum*

PREVIOUSLY FUNDED PROJECTS

In 2020 a total of 23 research projects are underway or proposed. Continuing and new projects for 2020 are described in the previous sections. Other projects, whose funding was approved and allocated in previous years, are in various stages of completion. These projects are briefly summarized below.

PROJECT 074 *(In Progress)*

Effect of Gas Gravity, H₂S, and Salinity on the Water Content in Natural Gas

This is an ongoing project with the goal of extending the work completed under Project 032 (RR-200) to mixtures with heavier hydrocarbons (e.g. gravity > 1.0), mixtures with CO₂, H₂S, and to verify the salinity correction.

The revision of the McKetta chart and the new thermodynamic model are based on the data reported in RR-200, data from other GPA Midstream projects (e.g. RR-174, RR-187), data provided by member companies (e.g. TP-28) and literature data. This work has identified the need for follow-up work beyond the original scope to fill-in gaps and address inconsistencies in the existing data. For example, some recent data are inconsistent with the historical correction for gas relative density.

Project 074 Part 1 on gas gravity correction has been published as RR-237. Part 2 (salinity correction) and Part 3 (H₂S) are in progress.

Investigator: *Alberta Sulfur Research Ltd.*

Project Coordinator: *Raymond French, Ray French Consulting LLC*

PROJECT 084.2 *(In Progress)*

Propane-Water-Methanol Mutual Solubility and Freeze Protection Phase 2: Correlation of Experimental VLE Data

The objective of this work is to develop and validate a stand-alone, accurate model to predict the VLE of the commercial propane-water-methanol system, based on the experimental data collected in the first phase of this project, Project 084: Propane-Water-Methanol Mutual Solubilities & Freeze Protection, and any other quality experimental data available.

Investigator: *Trimeric Corp.*

Project Coordinator: *Jeff Matthews, H2W United*

PROJECT 102 *(Final Report Under Review)*

High Pressure (1200 psia to 5000 psia) Hydrocarbon Mixtures Thermophysical Property and Vapor / Liquid / Equilibrium Data

The project focuses on the measurement of hydrocarbon mixture properties at elevated pressures. The purpose of this project is to fill gaps in hydrocarbon mixture data that are used for equipment design. The properties that will be measured are density, viscosity, thermal conductivity, surface tension, heat capacity, and vapor / liquid K values for the two phase mixtures, focusing in the region of the cricondenbar. This project will supplement the recent high pressure gas studies completed by GPA Midstream:

Project 985 – High Pressure Gas Separation and Conditioning (maximum pressure studied was 2500 psia)

Project 061 – Part 1 Glycols Transport Properties (maximum pressure studied was 2000 psia)

Project 043 – High Pressure Demethanizer Physical Properties (pressures from 700 to 1000 psia)

Specific data gaps include heat capacity data of natural gas mixtures at near-critical, two-phase conditions. These data are important for heat exchanger and compressor design. Similar gaps exist for viscosity and thermal conductivity, which are also important properties for equipment design. Existing predictive models for transport and physical properties of mixtures cannot be validated for natural gas mixtures near the critical point – at temperature and pressure around -90°F and 825 psig (0.95 < TR < 1.1 and PR > 1.0) – due to lack of data.

Investigator: *University of Western Australia/Minerals & Energy Research Institute of Western Australia*

Project Coordinator: *Brett Eldred, Targa Resources*

Project 133 *(In Progress)*

Co-Funded Project GPA Midstream/API Precision Improvement - High Performance Densitometer Calibration and Master Metering Proving Methodology

This project is to develop a master meter density proving method for hydrocarbon liquids, including densitometer calibration coefficients for various operating conditions. The master meter density proving method may also have applications for proving densitometers measuring viscous hydrocarbons which do not lend themselves to pycnometer proving. The scope will include:

- Improvement of density measurement precision by determining the calibration constants within the operating range of hydrocarbon liquids at the pressure, temperature and composition ranges expected at the density meter's installed location.
- Development of a master density meter proving method as an alternative to the pycnometer method which has the same performance level as pycnometer proving, while reducing the complexity and time required for the proving.

Investigator: TBA

Project Coordinators: Don Sextro, Targa Resources, GPA Midstream Measurement Committee
Sally Goodson, API

Project 144 *(Final Report Under Review)*

GPA Midstream Analysis Committee Round Robin Project

This project is to establish precision statements for four existing GPA Midstream Analytical Standards that currently lack the reference data set required for the development. The Standards are:

1. GPA 2103-03, "Tentative Method for the Analysis of Natural Gas Condensate Mixtures Containing Nitrogen and Carbon Dioxide by Gas Chromatography"
2. GPA 2186-02, "Method for the Extended Analysis of Hydrocarbon Liquid Mixtures Containing Nitrogen and Carbon Dioxide by Temperature Programmed Gas Chromatography"
3. GPA 2199-99, "The Determination of Specific Sulfur Compounds by Capillary Gas Chromatography and Sulfur Chemiluminescence Detection"
4. GPA 2286-95, "Tentative Method of Extended Analysis for Natural Gas and Similar Gaseous Mixtures by Temperature Programmed Gas Chromatography"

Consultant: David D'Agostaro, D'Agostaro Energy Measurement Services

Project Coordinator: Joe Landes, SPL Inc., GPA Midstream Analysis Committee Chair

Project 151 *(In Progress)*

Mercaptan Vapor Liquid Equilibrium in TEG and EG

This project is to determine the VLE of methyl mercaptan and ethyl mercaptan at conditions encountered in TEG dehydration units. Additionally, the VLE of these mercaptans in EG for mixtures typical of hydrate inhibition systems will be determined.

Investigator: LTP

Project Coordinator: Mike Hlavinka, Bryan Research & Engineering

Project 161 *(In Progress)*

Methanol in Gas Conditioning Systems

This project's objective is to measure VLE of methanol in amine sweetening and dehydration solvents representative of those encountered in gas processing. This will enhance determination of methanol contamination of these systems. The project will fill gaps in existing data, as well as acquire data on systems that have yet to be measured. These include additional hydrocarbons instead of only methane and propane, new amine solvents, and loaded amine systems containing hydrogen sulfide with and without carbon dioxide. Additionally, some of the data presented in RR-177 will be re-measured, since these data have material balance issues.

Investigator: LTP

Project Coordinator: Oliver Koch, Linde Engineering

Project 162 *(In Progress)*

NGL Treating LLE Data

This project is to measure COS and light mercaptan partitioning between a hydrocarbon phase and aqueous amines at operational conditions for liquid extraction units of interest for GPA Midstream members.

Investigator: Aalto University

Project Coordinator: Diego Cristancho, Dow Chemical Co.

Project 164 *(In Progress)***GPA Midstream Analysis Committee Round Robin Project**

The purpose of this project is to establish precision statements for three existing GPA Midstream analytical standards that currently lack the reference data set required for the development of precision statements for desired applications. The standards include GPA 2199-99 "The Determination of Specific Sulfur Compounds by Capillary Gas Chromatography and Sulfur Chemiluminescence Detection," GPA 2261-13 "Analysis for Natural Gas and Similar Gaseous Mixtures by Gas Chromatography," and GPA 2177-13 "Analysis of Natural Gas Liquid Mixtures Containing Nitrogen and Carbon Dioxide by Gas Chromatography."

Investigator: *David D'Agostaro, D'Agostaro Energy Measurement Services*
Project Coordinator: *GPA Midstream Analysis Committee*

Project 171 *(In Progress)***Data Reconciliation for Water Content of CO₂ at Hydrate-forming Conditions**

Data reported in RR-99 (1986) are widely used in industry for applications such as determining the dehydration requirements for CO₂-rich streams in Enhanced Oil Recovery (EOR) or Acid Gas Injection (AGI) operations. Recently, some laboratories independently measured selected data of water contents in liquid CO₂ at hydrate-forming conditions. They reported significant discrepancies compared to some data in RR-99. Since these data in dispute are fairly difficult to measure, the purpose of this project is to reconcile the discrepancies.

Investigator: *Colorado School of Mines*
Project Coordinators: *Håvard Lidal, Statoil ASA*
Jeff Hammond, ONEOK

Project 172 *(In Progress)***Solids Formation in LPG in the Presence of Methanol**

The intent of this project is to fill the gaps in collected data to enable accurate prediction of freeze behavior of LPG-water systems and the impact of added methanol. Data will be measured for VLE of LPG-Water-Methanol mixtures sub-saturated with water and solids formation data in the presence of methanol, both at high pressure storage conditions and low pressure, low temperature conditions simulating that seen by a typical end user. Data will include binaries for typical hydrocarbons found in LPG mixtures (e.g. ethane, propanes, butanes) and multi-component LPG mixtures.

Investigator: *Colorado School of Mines*
Project Coordinators: *Mahmood Moshfeghian, Petroskills/John M. Campbell*
Steve Hummell, Anadarko Petroleum

Project 173 *(In Progress)***Thermodynamic Data for LNG Systems**

The purpose of this project is to provide thermodynamic data that will improve the basis for design of cryogenic equipment, especially the heat exchangers. The study will measure enthalpy, heat capacity and density data for LNG at subcooled temperatures at near ambient pressures.

Investigator: *Technische Universität Chemnitz*
Project Coordinators: *Pavan Adapa, Energy Transfer; Golikeri*

Project 181 *(In Progress)***Solubility of Light Ends in Heavy Condensate**

This project's aim is to improve the prediction of the vapor-liquid distribution of light hydrocarbons in heavy raw condensate production streams. These data will provide GPA Midstream members with the ability to accurately predict the quantity of flash vapors generated at field storage tanks and thus ensure adequate sizing of emission control devices such as a vapor recovery unit, combustor, or flare. Data will also allow more accurate simulation of the condensate stabilizer to meet the product vapor pressure specification. This project will result in improved prediction of the stabilizer bottom temperature requirements, as well as improved prediction of the required capacity of the vapor recovery system to handle the stripped light ends.

Investigator: *LTP*
Project Coordinator: *Mike Hegarty, H2W United*

Project 182 *(In Progress)*

Extension Project 111 - Comparison of GPA Data to Simulator Predictions

Project 111 – Comparison of GPA Data to Simulator Predictions focused on screening GPA Midstream thermodynamic data to test the predictive capability of commercial process simulators for different gas processing applications. In this project extension, comparisons will be made between the commercial simulator predictions and GPA Midstream experimental data for hydrocarbon/acid gas and sulfur compounds in glycols/amines and other data sets that were not covered in Project 111 (e.g. physical properties). The results of this project will provide GPA Midstream member companies with guidance on which simulators are the best tools to analyze specific gas processing applications.

Investigator: *Trimeric*
Project Coordinator: *Diego Cristancho, Dow Chemical Co.*

Project 183 *(On Hold)* **GPA Midstream Analysis, Test Methods & Product Specifications Committee Round Robin Project**

This project aims to expand precision statements for two existing GPA Midstream analytical standards and to validate recommendations for a GPA Midstream sampling standard. The standards are

- GPA 2177 - Analysis of Natural Gas Liquid Mixtures Containing Nitrogen and Carbon Dioxide by Gas Chromatography
- GPA 2103 - Analysis of Condensate Mixtures Containing Nitrogen and Carbon Dioxide by Gas Chromatography
- GPA 2174 - Spot Sampling of Natural Gas Liquids for Analysis by Gas Chromatography

Investigator: *TBD*
Project Coordinator: *Analysis, Test Methods & Product Specifications Committee*

Project 193 *(In Progress)*

Solubility of Mercury in Selected Gas Processing Solvents

The intent of this work is to determine solubility data for elemental mercury in conditions that closely resemble key separation equipment in gas plants. Specifically, the work will include:

- Literature search of existing mercury solubility data with relevant glycol, methanol and amine systems
- Measurement of liquid concentrations of mercury in selected glycol (MEG, TEG), amine (MEA, MDEA) and MeOH solutions

Investigator: *PS Analytical*
Project Coordinator: *Al Goethe, Enterprise Products Operating*

PROJECT 921 *(Ongoing)*

Enthalpy and Phase Equilibrium Database

This is an ongoing project to maintain an up-to-date, PC-compatible, database of validated experimental and phase equilibrium data that are needed for the proper design and operation of gas gathering and processing equipment. These data are particularly important in designing heat exchangers and towers at low temperature, high pressure, or high acid gas conditions. The GPA Midstream Data Bank delivers over 50 years of GPA Midstream research data for immediate, productive use in process simulation tools. Included is a completely remastered thermophysical property database with all Research Reports and Technical Publications and powerful data fitting, correlation, and phase equilibrium software.

Investigator: *Dortmund Data Bank Software & Separation Technology*
Project Coordinator: *Diego Cristancho, Dow Chemical Co.*

AUTHORIZATION and FUNDING PROCEDURES

Adequate and equitable funding, with a rigorous approval procedure and continuing oversight, are key elements in the impressive accomplishments of the GPA Midstream research program. Details of the authorization and funding procedure may be summarized as follows:

1. Research proposals usually originate in one of the two sub-groups of the Research Committee or other working sections of the GPA Midstream technical committees. The sub-groups are made up of research engineers and other technical specialists. Other technical committees are staffed by appropriate experts appointed by member companies. The responsible sub-group will outline a research schedule for a suitable project and recommend a level of funding to be incorporated in the general research budget.
2. Project proposals are submitted to the Technical Executive Committee (TEC) for general endorsement. The TEC represents all phases of GPA Midstream technical interest and thus provides an appropriate screen to ensure projects of specific need and broad industry application.
3. The proposal next goes to the Board of Directors, which must approve the project(s) by a majority of those present at the meeting. Once a project proposal is approved by the GPA Midstream Board of Directors, the project is considered approved by GPA Midstream membership and will move forward with each GPA Midstream member company contributing through a portion of its annual membership dues.
4. Following GPA Midstream Board approval and assured funding of a project, the originating sub-group or technical committee develops a detailed Request for Proposal which defines the problem, outlines work needed, and specifies funds available. Generally, proposals are solicited from select research organizations known to have facilities and interest appropriate to the proposed project.
5. Selection of the project investigator is made by the responsible sub-group or technical committee, and a contract is awarded. The sub-group or committee designates a project coordinator who works directly with the investigator and exercises oversight responsibility for the duration of the project. The project coordinator keeps the committee and GPA Midstream staff informed on project progress, problems and budgetary compliance. The Research Committee and GPA Midstream staff are charged with the responsibility of terminating a project if the contractors are not performing adequately as detailed in the project's agreement.

RESEARCH FISCAL SUMMARY

	GPA Midstream Production-Based Members Contribution	GPA Midstream/GPSA Non Production-Based Member Contributions, PERC Support and Research Reserve	TOTAL
1963-1970			\$ 827,000
1971-1980			1,950,000
1981-1990			4,403,700
1991-2000			3,360,000 ^{1, 2, 3, 4, 5}
2001-2010			4,225,000 ^{6, 7, 8, 9, 10}
2011	255,000	300,000 (PERC)	555,000 ⁸
2012	265,000	300,000 (PERC)	565,000 ⁸
2013	275,000	300,000 (PERC)	575,000 ⁸
2014	285,000	350,000 (300,000 from PERC)	635,000 ⁸
2015	290,000	335,000 (300,000 from PERC)	625,000 ⁸
2016	290,000	390,000 (300,000 from PERC)	680,000 ⁸
2017	280,000	380,000 (300,000 from PERC)	660,000 ⁸
2018	300,000	350,000 (300,000 from PERC)	650,000 ⁸
2019	300,000	350,000 (300,000 from PERC)	650,000 ⁸
2020	300,000	350,000 (300,000 from PERC)	650,000 ⁸

1 Does not include API co-funding of \$60,000 and GRI cofunding of \$400,000.

2 Does not include API co-funding of \$53,200 and GRI cofunding of \$900,000.

3 Does not include GRI co-funding of \$900,000 (1993), \$1,100,000 (1994 and 1995).

4 Does not include PERC co-funding of \$100,000, API/MMS/NPRA/CMA co-funding of \$100,000, and GPA Midstream Operating Fund/GPSA co-funding of \$40,000.

5 Does not include PERC co-funding of \$100,000.

6 Does not include PERC co-funding of \$50,000 and GPSA co-funding of \$25,000.

7 Does not include GPSA co-funding of \$25,000 and BP co-funding of \$50,000. Does include a one time grant of \$50,000 from GPSA for this year's program.

8 Does not include GPSA funding of \$25,000.

9 Does not include GPSA funding of \$25,000 nor Norsk Hydro's funding of Project 031.

10 Does not include GPSA Funding of \$25,000 nor Norsk Hydro's \$30,000 funding of Project 062.

RESEARCH REPORTS

Research reports are free to GPA Midstream and GPSA members and are accessible through the Members-Only Data Book and Publications Cloud. Any employee of member companies may access the cloud by visiting GPAmidstream.org/login and creating a free account for access. Once you create an account, from the Account Profile page, select Members Only Section and then click on NEW! Cloud-Based Data Book and Publications. All others wishing to receive copies of GPA Midstream research reports will pay of fee of \$500 per report and should call GPA Midstream to order: (918) 493-3872.

- RR-1** Bibliography of Data Sources for Low-Temperature Vapor-Liquid Equilibria in Non-Absorber Oil Systems - R. D. Gunn and S. V. Mainkar, University of Texas, Austin, Texas. Project 692-A. February, 1971.
- RR-2** K-Values in Highly Aromatic and Highly Naphthenic Real Oil Absorber Systems - Grant Wilson and Sherman T. Barton, P-V-T Inc., Houston, Texas. Project 691. March, 1971.
- RR-3** Enthalpy and Entropy of Non-Polar Liquids at Low Temperatures - K. C. Chao and R. A. Greenkorn, Purdue University, Lafayette, Indiana. April, 1971.
- RR-4** Evaluation of Eight Enthalpy Correlations - Kenneth E. Starling, David W. Johnson and Philip C. Colver, University of Oklahoma, Norman, Oklahoma. Project 681. May, 1971.
- RR-5** Experimental Measurements of Vapor-Liquid Equilibrium Data for the Ethane-Carbon Dioxide and Nitrogen-n-Pentane Binary Systems - Kurata-Swift Consulting Engineers, Lawrence, Kansas. Project 692-B. December, 1971.
- RR-6** Enthalpies of Methane-C7 Systems - Bert Eakin, Grant M. Wilson and Will E. DeVaney, P-V-T, Inc., Houston, Texas. Project 661. August, 1972.
- RR-7** The Equilibrium Phase Properties of the Binary Systems: Nitrogen-Hydrogen Sulfide, Isobutane-Hydrogen Sulfide, Isobutane-Carbon Dioxide and Isobutane-Ethane - D. B. Robinson and G. J. Besserer, University of Alberta, Edmonton, Alberta, Canada. June, 1972.
- RR-8** 1971-1972 Enthalpy Correlation Evaluation Study - Kenneth E. Starling, University of Oklahoma, Norman, Oklahoma. Project 713. October, 1972.
- RR-9** Enthalpies of Hydrogen Sulfide-Methane-Ethane Systems - Bert Eakin and Will E. DeVaney, P-V-T Inc., Houston, Texas. Project 722. February, 1975.
- RR-10** Solubility of Solid Carbon Dioxide in Pure Light Hydrocarbons and Mixtures of Light Hydrocarbons - Fred Kurata, Center for Research Inc., Lawrence, Kansas. February, 1974.
- RR-11** GPA Midstream Experimental Enthalpy Values Referred to Two Base Levels - John M. Lenoir and Gene A. Cochran, University of Southern California, Los Angeles, California. Project 733. September, 1974.
- RR-12** Enthalpy and Phase Boundary Measurements on Carbon Dioxide and Mixtures of Carbon Dioxide with Methane, Ethane and Hydrogen Sulfide - Grant M. Wilson and James M. Peterson, Brigham Young University, Provo, Utah. Project 731. June, 1975.
- RR-13** Prediction of Absorber Oil K-Values and Enthalpies - John H. Erbar, Oklahoma State University, Stillwater, Oklahoma. Project 714. March, 1977.
- RR-14** Solubility of Heavier Hydrocarbons in Liquid Methane - Fred Kurata, Center For Research Inc., Lawrence, Kansas. Project 738-A. March, 1975.
- RR-15** The Equilibrium Phase Properties of Selected Binary Systems at Low Temperature: Nitrogen-Hydrogen Sulfide, Ethane-Hydrogen Sulfide and n-Butane-Carbon Dioxide - D. B. Robinson and H. Kalra, University of Alberta, Edmonton, Alberta, Canada. Project 738. March, 1975.
- RR-16** Solubility Limits of Heavy Hydrocarbons in NGL and LNG Mixtures - Will DeVaney, Bert Eakin and James M. Berryman, P-V-T Inc., Houston, Texas. Project 735-A. November, 1975.
- RR-17** Smoothed Experimental Enthalpy Data for Three Methane-Ethane Binaries and a Methane-Ethane-Propane Ternary - John E. Powers, Andre W. Furtado, Ravi Kant and Adriana Kwan, University of Michigan, Ann Arbor, Michigan. Project 723. May, 1975.
- RR-18** The Equilibrium Phase Properties of Selected Binary Systems: n-Heptane-Hydrogen Sulfide, n-Heptane-Carbon Dioxide and i-Butane-Nitrogen - D. B. Robinson and H. Kalra, University of Alberta, Edmonton, Alberta, Canada. Project 745. August, 1976.
- RR-19** Vapor Phase Data for the Binary Systems of Methane with n-Butane, n-Pentane, n-Hexane and n-Heptane - Roger J. J. Chen, Patsy S. Chappellear and Riki Kobayashi, Rice University, Houston, Texas. Project 692-B. September, 1976.
- RR-20** K-Values for the Methane-n-Butane, Methane-n-Pentane and Methane-n-Hexane Systems - Doug Elliot, Y. N. Lin, T. C. Chu, Patsy S. Chappellear and Riki Kobayashi, Rice University, Houston, Texas. Project 692-B. September, 1976.
- RR-21** Dew-Point Values for the Methane-Carbon Dioxide System - S. C. Hwang, Ho-Mu Lin, Patsy S. Chappellear and Riki Kobayashi, Rice University, Houston, Texas. Project 739. September, 1976.
- RR-22** Solubility of Hydrocarbons in Cryogenic LNG and NGL Mixtures - James P. Kohn and Kraemer D. Luks, University of Notre Dame, Notre Dame, Indiana. Project 735. December, 1976.
- RR-23** Measurement of Ethane and Propane Recovery and Total Fraction Condensed for Simulated Natural Gas Mixtures - Grant M. Wilson, John R. Cunningham, B. Steve Lofgren and Veldon E. Messick, Thermochemical Institute, Brigham Young University, Provo, Utah. Project 737. May, 1977.

- RR-24** Enthalpy and Phase Boundary Measurements on Mixtures of Nitrogen with Methane, Carbon Dioxide and Hydrogen Sulfide - Grant M. Wilson, John R. Cunningham and Paul F. Nielsen, Brigham Young University, Provo, Utah. Project 741. May, 1977.
- RR-25** The Vapor-Liquid Equilibrium of the CH₄-CO₂ System at Low Temperatures - S. C. Mraw, S. C. Hwang and Riki Kobayashi, Rice University, Houston, Texas. Project 739. April, 1977.
- RR-26** Statistical Thermodynamics of Solutions in Natural Gas and Petroleum Refining - M. D. Donohue and J. M. Prausnitz, University of California, Berkeley, California. Project 721. July, 1977.
- RR-27** Solubility of Hydrocarbons in Cryogenic LNG and NGL Mixtures - James P. Kohn and Kraemer D. Luks, University of Notre Dame, Notre Dame, Indiana. Project 735-A. December, 1977.
- RR-28** The Characterization of the Heptanes and Heavier Fractions for the GPA Midstream Peng-Robinson Programs - D. B. Robinson and D. Y. Peng, University of Alberta, Edmonton, Alberta, Canada. Project 756. March, 1978.
- RR-29** The Equilibrium Phase Compositions of Selected Aromatic and Naphthenic Binary Systems: Toluene-Carbon Dioxide, Toluene-Hydrogen Sulfide, Methylcyclohexane-Carbon Dioxide and Methylcyclohexane-Hydrogen Sulfide - D. B. Robinson and H-J Ng, University of Alberta, Edmonton, Alberta, Canada. Project 755, 755A and 757B. March, 1978.
- RR-30** High Temperature V-L-E Measurements for Substitute Gas Components - Will DeVaney, James M. Berryman, Pen-Li Kao and Bert Eakin, P-V-T, Inc., Houston, Texas. Project 757. February, 1978.
- RR-31** The Equilibrium Phase Properties of a Synthetic Sour Gas Mixture and a Simulated Natural Gas Mixture - D. B. Robinson, H. Kalra and Hans Rempis, University of Alberta, Edmonton, Alberta, Canada. Project 737-A & 737-B. May, 1978.
- RR-32** Vapor-Liquid Compositions of Propane-Butane Mixtures in Cold Weather Field Tests - Thomas H. May and Dorab N. Baria, University of North Dakota, Grand Forks, North Dakota. Project 789-A. May, 1978.
- RR-33** Solubility of Hydrocarbons in Cryogenic LNG and NGL Mixtures - James P. Kohn and Kraemer D. Luks, University of Notre Dame, Notre Dame, Indiana. Project 735. November, 1978.
- RR-34** Sour Water Equilibria: Ammonia Volatility Down to ppm; Effect of Electrolytes on Ammonia Volatility; pH vs. Composition - Grant Wilson, Richard S. Owens and Marshall W. Roe, Wilco Research, Provo, Utah. Project 758-A. November, 1978.
- RR-35** Computer Simulations of Vapor-Liquid Compositions of Propane-Butane Mixtures in Cold Weather Field Tests - Thomas H. May and Dorab N. Baria, University of North Dakota, Grand Forks, North Dakota. Project 789-B. March, 1979.
- RR-36** Literature Survey for Synthetic Gas Components-Thermodynamic Properties - P. Pendergraft, M. Marston, M. Gonzales, V. Rice and J. Erbar, Oklahoma State University, Stillwater, Oklahoma. Project 746. October, 1979.
- RR-37** Enthalpy Measurements on Synthetic Gas Systems: Hydrogen-Methane, Hydrogen-Carbon Monoxide - James M. Berryman, Will E. DeVaney, Bert E. Eakin and Nancy L. Bailey, P-V-T, Inc., Houston, Texas. Project 742. August, 1979.
- RR-38** A Preliminary Version of the PHC Equation of State Computerized for Engineering Calculations - E. C. Hohmann, California State Polytechnic University, Pomona, California. Project 771. May, 1979.
- RR-39** The Equilibrium Phase Properties of Selected m-Xylene and Mesitylene Binary Systems: CH₂-m-Xylene, CO₂-m-Xylene, CH₄-Mesitylene - D. B. Robinson, H-J Ng and S-S Huang, University of Alberta, Edmonton, Alberta, Canada. Project 755-B. May, 1979.
- RR-40** Measurement of Ethane and Propane Recovery and Total Fraction Condensed in the Bubble Point Region of Two Simulated Natural Gas Mixtures - John R. Cunningham, John L. Oscarson and Mark L. Jensen, Brigham Young University, Provo, Utah. Project 737. February, 1980.
- RR-40-A** Phase Equilibria a High Nitrogen Content Synthetic Natural Gas - James P. Kohn and Robert C. Merrill, University of Notre Dame, Notre Dame, Indiana. Project 795. February, 1982.
- RR-41** Vapor-Liquid Equilibrium Data on Water-Substitute Gas Components: N₂-H₂O, H₂-H₂O, CO-H₂O and H₂-CO-H₂O and H₂S-H₂O - Paul C. Gillespie and Grant Wilson, Wilco Research Co., Provo, Utah. Project 758-B. April, 1980.
- RR-42** Predicting Synthetic Gas and Natural Gas Thermodynamic Properties Using a Modified Soave Redlich Kwong Equation of State - J. H. Erbar, A. K. Jagota, S. Muthswamy and M. Moshfeghian, Oklahoma State University, Stillwater, Oklahoma. Project 752. August, 1980.
- RR-43** The Equilibrium Phase Properties of Selected m-Xylene and Mesitylene Binary Systems: m-Xylene-Mesitylene-H₂S, Mesitylene-CO₂ - D. B. Robinson and S-S Huang, University of Alberta, Edmonton, Alberta, Canada. Project 755-B. June, 1980.
- RR-44** Vapor-Liquid and Liquid-Liquid Equilibria in the Methane-Toluene System and Relation of Liquid-Liquid Equilibrium Behavior at Low Temperatures to Vapor-Liquid Equilibria Behavior at High Temperatures and Elevated Pressures - Yeuh-Neu Lin, Shuen-Cheng Swang and Riki Kobayashi, Rice University, Houston, Scott W. Hopke, Exxon Production Company, Houston, Texas. Project 757. December, 1980.
- RR-45** The Water Content and Correlation of the Water Content of Methane in Equilibrium with Hydrates, (I); and the Water Content of a High Carbon Dioxide Simulated Prudhoe Bay Gas in Equilibrium with Hydrates, (II) - Keichi Aoyagi, Kyoo Y. Song and Riki Kobayashi, Rice University, Houston, Texas, E. Dendy Sloan and P. B. Dharmawardhana, Dept. of Chemical Engineering, Colorado School of Mines, Golden, Colorado. Project 775. December, 1980.
- RR-46** Vapor Liquid Equilibrium Study of the H₂-CH₄ System at Low Temperatures and Elevated Pressures - Joint research report for GPA Midstream and Gas Research Institute. Jane Huey Hong and Riki Kobayashi, Rice University, Houston, Texas. Project 757. December, 1980.

- RR-47** Behavior of CH₄-CO₂-H₂S Mixtures at Sub-Ambient Temperatures - Joint research report for GPA Midstream and Canadian GPA Midstream Association. D. B. Robinson, H-J. Ng and A. D. Leu, University of Alberta, Edmonton, Alberta, Canada. Project 738-A. January, 1981.
- RR-48** Vapor-Liquid and Liquid-Liquid Equilibria: Water-Methane; Water-Carbon Dioxide; Water-Hydrogen Sulfide; Water-nPentane; Water-Methane-nPentane - Paul Gillespie and Grant Wilson, Wiltec Research Company, Provo, Utah. Project 758-B. April, 1982.
- RR-49** Liquid-Liquid-Vapor Equilibria in Cryogenic LNG Mixtures - James P. Kohn, University of Notre Dame, Notre Dame, Indiana and Kraemer Luks, University of Tulsa, Tulsa, Oklahoma. Project 795. March, 1981.
- RR-49-A** Liquid-Liquid-Vapor Equilibria in Cryogenic LNG Mixtures (Raw Data) - James P. Kohn, University of Notre Dame, Notre Dame, Indiana and Kraemer D. Luks, University of Tulsa, Tulsa, Oklahoma. Project 795. March, 1982.
- RR-50** Measurement and Interpretation of the Water Content of a Methane-Propane (5.31 mol %) Mixture in the Gaseous State in Equilibrium with Hydrate - Hyoo Y. Song and Riki Kobayashi, Rice University, Houston, Texas. Project 775. January, 1982.
- RR-51** The Equilibrium Phase Properties of Selected Naphthenic Binary Systems: Methylcyclohexane- Nitrogen, Ethylcyclohexane-Hydrogen Sulfide and n-Propylcyclohexane-Hydrogen Sulfide - D. B. Robinson, S-S Huang and A. D. Leu, University of Alberta, Edmonton, Alberta, Canada. Project 755-B. March, 1981.
- RR-52** Vapor-Liquid Equilibria for Sour Water Systems with Inert Gases Present - Jonathan L. Owens, John R. Cunningham and Grant Wilson, Wiltec Research Co., Provo, Utah. Project 805. April, 1982.
- RR-53** Experimental Densities and Enthalpies for Water-Natural Gas Systems - John J. Scheloske, Kenneth R. Hall, Philip T. Eubank and James C. Holste, Texas A&M University, College Station, Texas. Project 772. September, 1981.
- RR-53-A** Thermophysical Properties Tables for Wet, Sweet and Sour Natural Gases: Data Supplement to RR-53 - John J. Scheloske, Kenneth R. Hall, Philip T. Eubank and James C. Holste, Texas A&M University, College Station, Texas. Project 772. November, 1981.
- RR-54** The Equilibrium Phase Behavior of Several Solute Gases in the Solvent Phenanthrene - Robert L. Robinson, Jr., Philip J. Carlberg, John J. Heidman and Yick-Kwan Chen, Oklahoma State University, Stillwater, Oklahoma. Project 757-A. November, 1981.
- RR-55** Phase Equilibrium Studies for Methane/Synthesis Gas Separation: The Hydrogen-Carbon Monoxide-Methane System - Joint research report for GPA Midstream and Gas Research Institute. Jane Huey Hong and Riki Kobayashi, Rice University, Houston, Texas. Project 757. November, 1981.
- RR-56** Measurement of Total Fraction Condensed and Phase Boundary for a Simulated Natural Gas - Joint research report for GPA Midstream and Gas Research Institute. John L. Oscarson and Bert Saxey, Brigham Young University, Provo, Utah. Project 737. May, 1982.
- RR-57** The Phase Behavior of Two Mixtures of Methane, Carbon Dioxide, Hydrogen Sulfide and Water - D. B. Robinson, S-S Huang, A. D. Leu and H-J Ng, University of Alberta, Edmonton, Alberta, Canada. Project 758-A. February, 1982.
- RR-58** The Equilibrium Phase Properties of Selected Naphthenic Binary Systems: Ethylcyclohexane-Carbon Dioxide, Ethylcyclohexane-Nitrogen and Ethylcyclohexane-Methane - D. B. Robinson, C-J Chen and H-J Ng, University of Alberta, Edmonton, Alberta, Canada. Project 755-B. March, 1981.
- RR-59** Vapor-Liquid Equilibrium Measurements on the Systems N₂-Toluene, N₂-m-Xylene, and N₂-Mesitylene - S. Laugier, D. Legret, J. Desteve, D. Richon and H. Renon, ARMINES, Paris, France. Project 755-C. June, 1982.
- RR-60** Liquid-Liquid-Vapor Equilibria in Cryogenic LNG Mixtures: Phase II - James P. Kohn and Robert C. Merrill, University of Notre Dame, Notre Dame, Indiana and Kraemer D. Luks, University of Tulsa, Tulsa, Oklahoma. Project 795. March, 1982.
- RR-61** An Evaluation of the GPSA Engineering Data Book Volume Correction Factor Table for Light Ends - David B. Manley, University of Missouri, Rolla, Missouri. Project 819. March, 1982.
- RR-62** Water-Hydrocarbon Liquid-Liquid-Vapor Equilibrium Measurements to 530 degrees F - Joint research report for GPA Midstream and American Petroleum Institute. C. Jeffrey Brady, John R. Cunningham and Grant Wilson, Wiltec Research Co., Provo, Utah. September, 1962.
- RR-63** Experimental Enthalpies for Pure Toluene and Pure Methylcyclohexane - Luis E. Cediol, Philip T. Eubank, James C. Holste and Kenneth R. Hall, Texas A&M University, College Station, Texas. Project 792-82. December, 1963.
- RR-64** Development of GPA Midstream Data Bank of Selected Enthalpy and Equilibria Values - Thomas E. Daubert, Pennsylvania State University, University Park, Pennsylvania. Project 806/822. March, 1983.
- RR-64-A** GPA Midstream Data Bank of Selected Enthalpy and Equilibria Values - Thomas E. Daubert, Pennsylvania State University, University Park, Pennsylvania. Project 806/822. April, 1986.
- RR-64-B** GPA Midstream Data Bank of Selected Enthalpy and Equilibria Values - Thomas E. Daubert, Pennsylvania State University, University Park, Pennsylvania. Project 806/822-89. June, 1990.
- RR-64-C** GPA Midstream Data Bank of Selected Enthalpy and Equilibria Values - Thomas E. Daubert, Pennsylvania State University, University Park, Pennsylvania. Project 806/822. January, 1993.
- RR-65** Vapor-Liquid Equilibria for Sour Water Systems at High Temperatures - Jonathan L. Owens, John R. Cunningham and Grant M. Wilson, Wiltec Research Co., Provo, Utah. Project 805-82. August, 1983.
- RR-66** Equilibrium Phase Composition and Hydrating Conditions in Systems Containing Methanol, Light Hydrocarbons, Carbon Dioxide and Hydrogen Sulfide - Joint research report for GPA Midstream and Canadian GPA Midstream Association. H-J. Ng and D. B. Robinson, D. B. Robinson & Assoc., Ltd., and University of Alberta, Edmonton, Alberta, Canada. Project 825-82. April, 1983.

- RR-67** Liquid-Liquid-Vapor Equilibria in Cryogenic LNG Mixtures: Phase III-Nitrogen Rich Systems - James P. Kohn and Robert C. Merrill, Jr., University of Notre Dame, Notre Dame, Indiana and Kraemer D. Luks, University of Tulsa, Tulsa, Oklahoma. Project 795-82. May, 1983.
- RR-68** Excess Enthalpy Experimental Data-Binary Systems: Water + n-Pentane, Water + n-Hexane, Water + n-Heptane, Water + n-Octane - C. J. Wormald, C. N. Colling, N. M. Lancaster and A. J. Sellers, University of Bristol, Bristol, England. Project 773-A-79. May, 1983.
- RR-69** Evaluation of GPA Midstream*SIM Computer Program with GPA Midstream Data Bank of Selected Enthalpy Values - Thomas E. Daubert, Pennsylvania State University, University Park, Pennsylvania. Project 822-82. July, 1983.
- RR-70** Phase Equilibrium Studies for Processing of Gas From CO₂ EOR Projects - Project supported jointly by the GPA Midstream Association and special industry contributions. Jane Huey Hong and Riki Kobayashi, Rice University, Houston, Texas. Project 826-82. August, 1983.
- RR-71** Water Content of NGL in Presence of Hydrates - Kevin A. Sparks and E. Dendy Sloan, Colorado School of Mines, Golden, Colorado. Project 775-B-82. September, 1983.
- RR-72** Measurement of Ethane and Propane Recovery and Total Fraction Condensed for a Simulated Natural Gas in the Retrograde Region - John L. Oscarson, Brigham Young University, Provo, Utah. Project 815-81. December, 1983.
- RR-73** Heats of Mixing of Steam with N₂, CO₂, H₂, CH₄, and CO at High Temperatures and Pressures Using a New High Temperature Calorimeter - Grant M. Wilson and C. Jeff Brady, Wiltec Research Co., Provo, Utah. Project 773-79 & 80. December, 1983.
- RR-74** The Influence of Methanol on Hydrate Formation at Low Temperatures - H-J. Ng and D. B. Robinson, D. B. Robinson & Assoc. Ltd., Edmonton, Alberta, Canada. Project 825-83. March, 1974.
- RR-75** Vapor-Liquid Equilibria Measurements on the Systems N₂-n-Propylcyclohexane, CO₂-n-Propylcyclohexane, CH₄-n-Propylcyclohexane, CH₄-n-Propylbenzene and CO₂-n-Propylbenzene - S. Laugier, P. Alali, A. Valtz, A. Chareton, F. Fontalba, D. Richon and H. Renon, ARMINES, Paris, France. Project 755-C-82. February, 1984.
- RR-76** Phase Equilibrium Studies for Processing of Gas from CO₂ EOR Projects-Phase II - Project supported jointly by the GPA Midstream Association and special industry contributions. Jane Huey Hong and Riki Kobayashi, Rice University, Houston, Texas. Project 826-83. February, 1984.
- RR-77** Evaluation of GPA Midstream*SIM Computer Program with GPA Midstream Data Bank of Selected V-L-E Data - Thomas E. Daubert, Pennsylvania State University, University Park, Pennsylvania. Project 806-83. May, 1984.
- RR-78** Sulfur Compounds and Water V-L-E and Mutual Solubility MESH-H₂O; ETSH-H₂O; CS₂-H₂O; and COS-H₂O - Paul C. Gillespie and Grant M. Wilson, Wiltec Research Co., Provo, Utah. Project 758-80. May, 1984.
- RR-79** Liquid-Liquid-Vapor Equilibria in Cryogenic LNG Mixtures (Phase IV - Nitrogen-Rich Systems) - James P. Kohn and Feliciano M. Llave, University of Notre Dame, Notre Dame, Indiana and Kraemer D. Luks, University of Tulsa, Tulsa, Oklahoma. Project 795-83. June, 1984.
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- RR-191** State of Mercury Removal Technology - Kent Pennybaker, Thomas Ruddy, River City Engineering Inc, Lawrence, Kansas. Project 051-1. July, 2006.
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- RR-193** High Pressure Gas Separation and Conditioning - Heng-Joo Ng, Shawn Taylor, Helmut Schroeder, and Don Sieben, Oilphase-DBR Schlumberger, Edmonton, Alberta, Canada. Project 985. January, 2008.
- RR-194** Gas Hydrate Plug Dissociation Kinetics and Predictive Model Development - Kenneth N. Marsh and Thomas J. Hughes, University of Canterbury, Christchurch, New Zealand. E. Dendy Sloan, Colorado School of Mines, Golden, Colorado. Project 036. January, 2008.

- RR-195** Mutual Solubility of Hydrocarbons and Amines - S. Mokraoui, A. Valtz, C. Couquelet, D. Richon, Armines, Paris, France. Project 021. January, 2008.
- RR-196** Testing of Instruments for Measuring Hydrocarbon Dew Points In Natural Gas Streams, Phase 1 - D.L. George, Ph.D., R.C. Burkey, Southwest Research Institute, San Antonio, Texas. Project 063. January, 2008.
- RR-197** Moisture Analyzers Survey - Howard S. Meyer, Osman Akpolat, Gas Technology Institute, Des Plaines, Illinois. Project 022. April, 2008.
- RR-198** Water and Inhibitor Distribution in Gas Product Systems - Antonin Chapoy, Amir H Mohammadi, Alain Valtz, Christopher Coquelet, Dominique Richon, Armines, Paris, France. Project 987. February, 2008.
- RR-199** Testing of Methods for Measuring Hydrocarbon Dew Points, Part 2 - D.L. George, Ph.D., R.A. Hart. Southwest Research Institute, San Antonio, Texas. Project 063. September, 2008.
- RR-200** Water Content of High Pressure, High Temperature Methane, Ethane and Methane +CO₂, Ethane + CO₂ - Matt Yarison, Kyoo Y. Song, Kenneth R. Cox, Dick Chronister, Walter G. Chapman. Rice University, Houston, Texas. Project 032. March, 2008.
- RR-201** Oxygen Removal in Natural Gas Systems - Rosalind Jones, Ken McIntush, and Charlie Wallace, Trimeric Corporation, Buda, Texas. Project 073. February 2010.
- RR-202** Vapour-Liquid Equilibrium, Interfacial Tension and Transport Properties of Aqueous Solutions of Ethylene Glycol or Triethylene Glycol in the Presence of Methane, Carbon Dioxide and Hydrogen Sulfide – Heng-Joo Ng, Na Jia, Yuengsheng Cheng, Kurt A. G. Schmidt and Herlmut Schroeder. DBR Technology Center, Edmonton, Alberta, Canada. Project 061. September 2009.
- RR-203** High Pressure Demethanizer Physical Properties - Sven Horstmann, Andreas Grybat, Christian Ihmels, and Kai Fischer. LTP GmbH University of Oldenburg, Oldenburg, Germany. Project 043. September 2010.
- RR-204** Impact of Sulfur Species on Glycol Dehydration (GPA Midstream 992-3): Solubility Study of Certain Sulfur Species in Glycol Aqueous Solutions – Waheed Afzal, Amir H. Mohammadi and Dominique Richon, Armines, Paris, France. Project 992-3. January 2008.
- RR-205** Hydrates in High Inhibitor Concentration Systems - A. Chapoy and B. Tahidi, Hydract Limited, Edinburgh, UK. Project 062-1. October 2010.
- RR-206** Solubility of Hydrocarbons in Amine Solutions - GPSA Data Book Project. Darryl Mamrosh, Kevin Fisher and Carrie Beitler, Trimeric, Buda, Texas. Project 975-5. October, 2011.
- RR-207** Vapor-Liquid Equilibrium Studies of Organic Sulfur Species in MDEA, DEA Aqueous Solutions - Christophe Coquelet, Javeed A. Awan, Eric Boonaert, Alain Valtz, Pascal Théveneau and Dominique Richon. Project 037. April 2011.
- RR-208** Methanol Solubility in Natural Gas - Darryl Mamrosh, Kevin Fisher and Teresa Kerr, Trimeric, Buda, Texas. Project 975-7. October, 2011.
- RR-209** CO₂/H₂S Solubility in Glycol - Darryl Mamrosh, Kevin Fisher and Carrie Beitler, Trimeric, Buda, Texas. Project 975-8. October, 2011.
- RR-210** Acid Gas Water Content – GPSA Data Book Project - Walter Chapman and Kyoo Y. Song, Rice University, Houston, Texas. Project 975-6. October, 2011.
- RR-211** Hydrates in High Inhibitor Concentration Systems - Bahman Tohidi, R. Burgass and Antonin Chapoy, Hydract, Edinburgh, UK. Project 062-1 Part 2. October, 2011.
- RR-212** Glycol Systems With Impurities - Christian Ihmels, Sarah Thiede, Sven Horstmann, and Andreas Grybat, LTP GmbH Oldenburg, Oldenburg, Germany. Project 031. October, 2011.
- RR-213** Practical Hydrocarbon Dew Point Specification for Natural Gas Transmission Lines - Jerry A. Bullin and Karl Fitz, Bryan Research and Engineering, Bryan, Texas. Todd Dustman, Questar Pipeline Company, Salt Lake City, Utah. Project 081. March, 2011.
- RR-214** Solubility of Non-Aromatic Hydrocarbons in TEG Solutions - Sven Horstmann, Christian Ihmels, and Andreas Grybat, LTP GmbH. Project 083. December, 2011.
- RR-215** Equilibrium Data (SLE and VLE) for Heavy and Light Hydrocarbons at Cryogenic Temperatures, Louis V. Jaspersen, Rubin J. McDougal and Grant M. Wilson, Wiltec Research Co., Inc., Provo, Utah, Project 035, June, 2014.
- RR-216** Hydrates in High Inhibitor Concentration Systems - H. Adidharma, M. Radosz. University of Wyoming, Laramie, Wyoming. Project 062-2. June, 2012.
- RR-217** GPA Midstream Technical Data Development Committee Support for GPSA Data Book 13th Edition - Brian Walter and Barry Friedman, URS Corporation, Denver, Colorado. Project 975-9. June, 2012.
- RR-218** Loaded Amine Transport Properties - Christian Ihmels, Sarah Thiede, Sven Horstmann, and Andreas Grybat, Oldenburg, Germany. Project 061-2. March, 2013.
- RR-219** Methanol Distribution (As A Contaminant) in Fractionation Products and Freeze Out Boundaries - Xavier Courtial, Eric Booneart, Alain Valtz, Pascal Theveneau, Paolo Stringari, Christophe Coquelet, Armines, Paris, France. Project 052. March, 2013.
- RR-220** Solubility of Heavy Hydrocarbons in Loaded Amine Solutions, Sven Horstmann, Andreas Grybat and Christian Ihmels, LTP GmbH, University of Oldenburg, Project 071, March, 2014.
- RR-221** Distribution of Sulfur Species in 3-Phase Separators, Sven Horstmann, Andreas Grybat and Christian Ihmels, LTP GmbH, University of Oldenburg, Project 072, March, 2014.
- RR-222** Corrosion in Acid Gas Injection Systems, Kenneth McIntush P.E., and Kevin Fisher, P.E., Trimeric Corporation, Buda, Texas, and Peter Ellis, Honeywell Process Solutions, Project 101, June, 2014.

- RR-223** Freeze Valve Water Content in LPG Systems, Todd Willman, Andrew Eckles and Dr. Kenneth R. Hall, National Thermodynamic Laboratory Inc., Galveston, Texas; Bob Franklin, Susan Brandon and Lesong Yan, Airgas Specialty Gas, Houston, Texas, Project 085, June, 2014.
- RR-224** Elemental Mercury Equilibrium in Selected Saturated Hydrocarbons - Steven J. M. Butala, Grant M. Wilson and Louis V. Jasperson, Wiltec Research Co. Inc., Provo, Utah. Project 051.2. February, 2016.
- RR-225** Solubility of Hydrocarbons in Aqueous Piperazine and Aqueous Piperazine/MDEA Systems and Associated Properties - Karl Anders Hoff, Inna Kim, Andreas Grimstvedt, Bård Bjørkvik and Hanna Knuutila, SINTEF Materials and Chemistry, Trondheim, Norway. Project 122. October, 2015.
- RR-226** Solubility of Amines and TEG In Dense Phase Gases - Kevin Fisher and Philip Lowell, Trimeric Corp, Buda, Texas; Francis Huang, Southwest Research Institute, San Antonio, Texas. Project 121. April, 2016.
- RR-227** Organic Sulfur Species Distribution In Glycols and Amines - Carrie Beitler and Darryl Mamrosh, Trimeric Corp., Buda, Texas. Project 975-10(1). December, 2015.
- RR-228** Sulfur Species Distribution in Separators and Fractionators – Leah Granger, Averi Lorenzi and Marco Satyro, Clarkson University, Potsdam, New York; Carl Landra, Virtual Materials Group, Calgary, Alberta, Canada. Project 975-10(2). September, 2015.
- RR-229** Impacts of Inhibitors on Hydrates – Pramod Warriar, Naveed Khan, Md., Noor Arifin and Carolyn Koh, Colorado School of Mines, Golden, Colorado. Project 975-12. January, 2016.
- RR-230** Impact of Aromatics on Acid Gas Injection – Martha Hajiw, Eric Boonaert, Alain Valtz, Elise El Ahmar, Antonin Chapoy, and Christophe Coquelet, Mines ParisTech, Armines, PSL Research University, Paris, France and Heriot Watt University, Edinburgh, United Kingdom. Project 082. May, 2016.
- RR-231** Propane-Water-Methanol Mutual Solubilities & Freeze Protection – Dr. Andreas Grybat, Dr. Sven Horstmann, and Dr. Christian Ihmels, LTP (Laboratory for Thermophysical Properties) GmbH, Associate Institute of Oldenburg, Oldenburg, Germany. Project 084. October, 2016.
- RR-232** State-Of-The-Art Review of Mercaptan Removal Technologies – Paul Roberts, WorleyParsons, London, United Kingdom. Project 152. October, 2016.
- RR-233** Measurements of Densities, Viscosities, Thermal Conductivities, Enthalpies and Hydrate Melt Temperatures for Four Acid Gas Blends from 75oF to 250oF at Pressures of 1000 to 5000 – David M. VonNiederhausen, Neil F. Giles, Grant M. Wilson, Louis V. Jasperson, Wiltec Research Co., Inc., Provo, Utah. Project 042. June, 2017.
- RR-234** State of the Art Survey for Heavy Hydrocarbon Removal and Disposition Associated with LNG Production Facilities – Adrian Finn, Adil Farooq, Costain, Manchester, United Kingdom. Project 163. July, 2017.
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- RR-236** Acid Gas Transport Properties Near Physical Phase Envelope – Dr. Andreas Grybat, Dr. Sven Horstmann, and Dr. Christian Ihmels, LTP (Laboratory for Thermophysical Properties) GmbH, Associate Institute at the University of Oldenburg, Oldenburg, Germany. Project 143. September, 2017.
- RR-237** Effect of Gas Gravity, H₂S, and Salinity on the Water Content in Natural Gas: Part I, Effect of Gas Gravity – Connor Deering, Sarah K. Carefoot, Francis Bernard, Binod R. Giri, and Robert A. Marriott, Alberta Sulfur Research Ltd, University of Calgary, Calgary, Alberta, Canada. Project 074. September, 2017.
- RR-238** Extended Mercaptan VLE in Loaded Amines: Part I – Eric Boonaert, Alain Valtz, and Christophe Coquelet, Mines ParisTech Centre, Paris, France. Project 142. December, 2018.
- RR-239** Extended Mercaptan VLE in Loaded Amines: Part II – Eric Boonaert, Alain Valtz, and Christophe Coquelet, Mines ParisTech Centre, Paris, France. Project 142. December, 2018.
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- RR-242** Solubility of Hydrocarbons in Amine Treating Solutions - Petri Uusi-Kyyny, Minna Pakkanen, Dominique Richon, Simona Ionita, Emmanuel Ogunrobo and Ville Alopaeus. Aalto University, Aalto, Finland. Project 141. May, 2019.

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- TP-1** Liquid Densities of Ethane, Propane and Ethane Propane Mixtures - J. R. Tomlinson, Gulf Research & Development Co., Pittsburgh, Pennsylvania. February, 1971.
- TP-2** Liquid Densities of High Ethane Raw Make Streams - T. K. Provence, Jr., Mobil Pipe Line Co., L. D. Wiener and D. K. Walton, Mobil Research & Development Corp., Dallas, Texas. February, 1972.
- TP-3** A Model for the Precise Calculation of Liquefied Natural Gas Densities - M. A. Albright, Phillips Petroleum Co., Bartlesville, Oklahoma. June, 1973.
- TP-4** Low Temperature Data from Rice University for Vapor Liquid and P V T Behavior - R. Kobayashi, P.S. Chappellear and T.W. Leland, Rice University, Houston, Texas. April, 1974.
- TP-5** Relation of Liquid Liquid Equilibrium Behavior at Low Temperatures to Vapor Liquid Equilibria Behavior at High Temperatures and Elevated Pressures - S. C. Hwang, Y. Lin and R. Kobayashi, Rice University and S.W. Hopke, Exxon Production Research Co., Houston, Texas. August, 1978.
- TP-6** Experimentally Based Thermodynamic Properties of Propane - V. L. Bhirud and J. E. Powers, University of Michigan, Ann Arbor, Michigan. January, 1982.
- TP-7** Excess Enthalpy Experimental Data, Binary Systems: Water Hydrogen, Water Methane, Water Nitrogen, Water Argon - C. J. Wormald, C. N. Colling, University of Bristol, Bristol, England. June, 1982.
- TP-8** The Solubility of Carbon Dioxide in Propylene Carbonate at Elevated Pressures and Higher Than Ambient Temperatures - P.D. Mantor, O.Abib, Jr., K.Y. Song and R. Kobayashi, Rice University, Houston, Texas. July, 1982.
- TP-9** The Water Content and the Solubility of CO₂ in Equilibrium with DEG Water and TEG Water Solutions at Feasible Absorption Conditions - S. Takahashi and R. Kobayashi, Rice University, Houston, Texas. December, 1982.
- TP-10** Hydrate Decomposition Conditions in the System Hydrogen Sulfide, Methane and Propane - J. P. Schroeter and R. Kobayashi, Rice University and H. A. Hildebrand, Exxon Production Research Co., Houston, Texas. December, 1982.
- TP-11** Vapor Liquid Equilibria Study of Light Gases in Hydrogen Coal Liquid Model Compound Systems - T. Kragas and R. Kobayashi, Rice University, Houston, Texas. August, 1983.
- TP-12** Liquid Densities of Ethane Propane Mixtures - W. R. Parrish, Phillips Petroleum Co., Bartlesville, Oklahoma. February, 1985.
- TP-13** Experimental Orifice Meter Studies - R. G. Teyssandier, Z. D. Husian and M. F. Zendan, Daniel Industries Inc., Houston, Texas. February, 1985.
- TP-14** Energy Functions for Gaseous CO₂ H₂O Mixtures - M.R. Patel, J.C. Holste, K.R. Hall and P.T. Eubank, Texas A&M University, College Station, Texas. May, 1987.
- TP-18** GPA Midstream Experimental Enthalpy Values Referred to Two Base Levels from Excess Enthalpy Data - P.S. Chappellear, Houston, Texas. October, 1989.
- TP-19** Vapor Solid Equilibrium Ratios for Structure I and Structure II Natural Gas Hydrates - S.L. Mann, Mobil Oil Corp., L.M. McClure, Columbus Energy Corp., E.D. Sloan and F.H. Poettmann, Colorado School of Mines. December, 1988.
- TP-20** Effects of Amonia on LP-Gas Odorant - J.W. Goetzinger and D.L. Ripley, National Institute for Petroleum Energy Research, Bartlesville, Oklahoma. May, 1996.
- TP-21** Trace Contaminants in Natural Gas Liquids - GPA Midstream Technical Section C, Product Specifications, Tulsa, Oklahoma. July, 1996.
- TP-22** Convergence Pressure and Vapor-Equilibrium Ratios - GPSA Editorial Review Board, Tulsa, Oklahoma. June, 1999.
- TP-24** Solubility and Vapor-Liquid Equilibrium Data for Systems Containing Diamondoids, Gas Mixtures, Feed Stock Oil, and Triethylene Glycol - Heng-Joo Ng, DB Robinson Research Ltd., Edmonton, Alberta, Canada. December, 1997.
- TP-26** Mutual Solubility in Water / Methanol Hydrocarbon Solutions - DB Robinson Research Ltd., Edmonton, Alberta, Canada and Norsk Hydro, Oslo, Norway. May, 2000.
- TP-28** Water Content of CO₂ Rich Phase of Gaseous Mixtures Containing 10-20 Mol Percent CH₄ in CO₂ in Equilibrium with Water and/or Hydrate - Kyoo Song, Riki Kobayashi, Walter Chapman, Rice University, Houston, Texas. March, 2003.
- TP-29** Hydrocarbon / Water and Hydrocarbon / Aqueous Amines Mutual Solutions - Huntsman supplied data. August, 2003.
- TP-30** Foaming In Glycol and Amine Systems - Howard S. Meyer, Gas Technology Institute. Project 006. July, 2007.
- TP-31** GPA 2261 and GPA 2177 Methods Precision Statements Calculation - Ricardo Aguiar, Movilab, S.A. de C.V. Naucalpan, Edo. Mexico, April, 2014.
- TP-32** Water Content in Gaseous and Liquid Carbon Dioxide and its Mixture with Methane in Equilibrium with Hydrate - Kyoo Y. Song, Kenneth R. Cox, Walter G. Chapman, Rice University, Houston, Texas. May, 2019.

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It was initiated in 1985 to recognize outstanding accomplishments in gas processing research and technology, and/or for excellence in engineering education. Dr. Katz was closely associated with GPA Midstream and the natural gas industry during his long and distinguished career. He and his students developed much of the classic data and many of the correlations that are essential to understanding the science and engineering of light hydrocarbon production and processing. He was the 1950 recipient of the GPA Midstream Hanlon Award, the first of some 21 major scientific honors and awards received during his career.

The Katz Award, symbolized by a wall plaque bearing an engraved likeness of the late Dr. Katz, is not an annual event, but is conferred as deemed appropriate by GPA Midstream research leaders.

DONALD L. KATZ AWARD RECIPIENTS

1985	Dr. Riki Kobayashi, Rice University
1986	Dr. Don Robinson, D. B. Robinson & Associates
1987	None
1988	Dr. James P. Kohn, University of Notre Dame
1989	Dr. Grant Wilson, Wiltec Research Co.
1990	Dr. Frank Dotterweich, Texas A&I University
1991	None
1992	Dr. John Prausnitz, University of California, Berkeley
1993	Dr. Fred Poettmann, Colorado School of Mines
1994	Dr. K. C. Chao, Purdue University
1995	None
1996	Dr. John Erbar, Oklahoma State University (posthumous)
1997	Dr. Kenneth Hall, Texas A&M University
1998	Dr. Fred D. Otto, University of Alberta Dr. Alan Mather, University of Alberta
1999	Dr. Orville Sandall, University of California
2000	Dr. E.Dendy Sloan, Jr., Colorado School of Mines
2001	Dr. Dominique Richon, ARMINES
2002	Dr. Raj Bishnoi, University of Calgary
2003	Dr. Ken Starling, University of Oklahoma and Starling & Associates
2004	Dr. Jerry Bullin, Texas A&M University and Bryan Research & Engineering
2005	Dr. Heng-Joo Ng, Oilphase - DBR, Edmonton
2006	Dr. Ding-Yu Peng, University of Saskatchewan
2007	Dr. Ken Marsh, University of Canterbury
2008	Dr. Peter Clark, University of Calgary
2009	Dr. James F. Ely, Colorado School of Mines
2010	Dr. Walter G. Chapman, Rice University
2011	Dr. Gary T. Rochelle, University of Texas
2012	Dr. John J. McKetta Jr., University of Texas
2013	Dr. Arthur Kidnay, Colorado School of Mines
2014	Dr. William R. Parrish, Phillips Petroleum Co. (retired)
2015	Dr. Ralph Weiland, Optimized Gas Treating
2016	Dr. David F. Bergman, BP (posthumous)
2017	Dr. Kraemer Luks, University of Tulsa
2018	Dr. James C. Holste, Texas A&M University
2019	Robert A. Hubbard, Petroskills/John M. Campbell D. John Morgan, Petroskills/John M. Campbell Dr. Larry Lilly, Larry Lilly Consulting



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