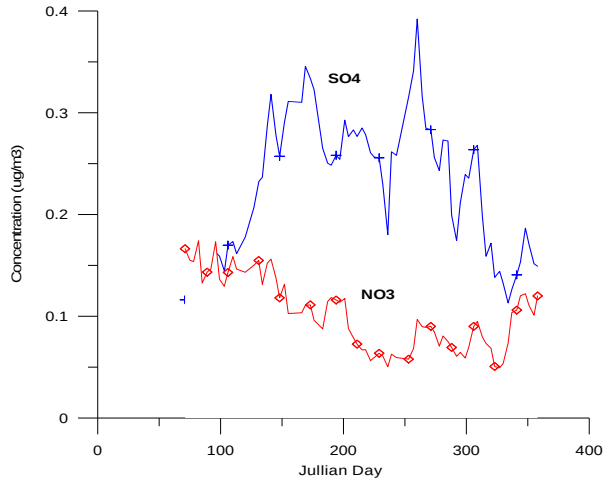
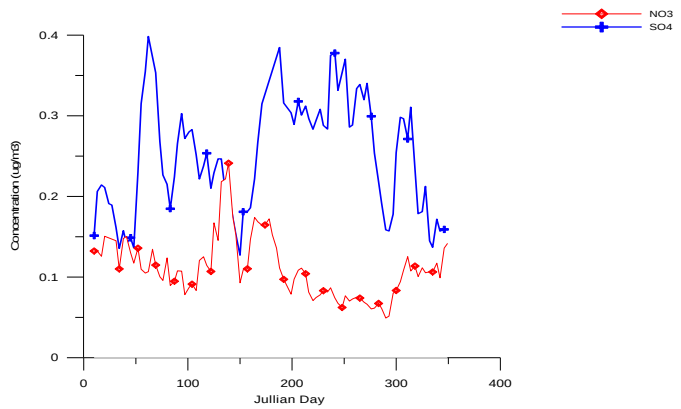
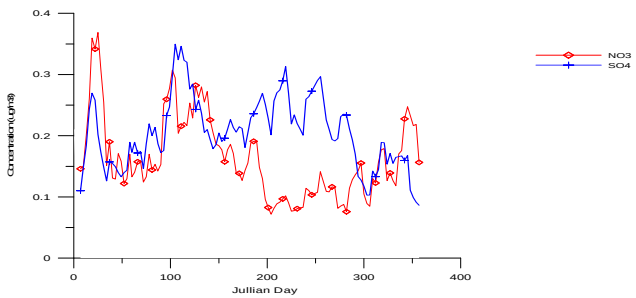
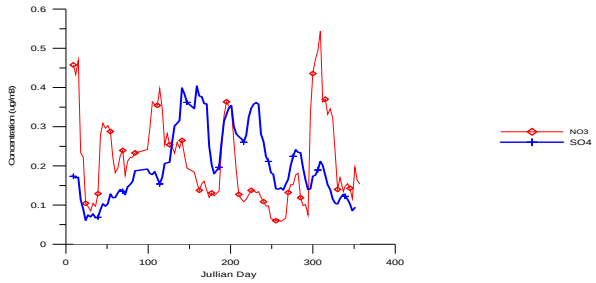
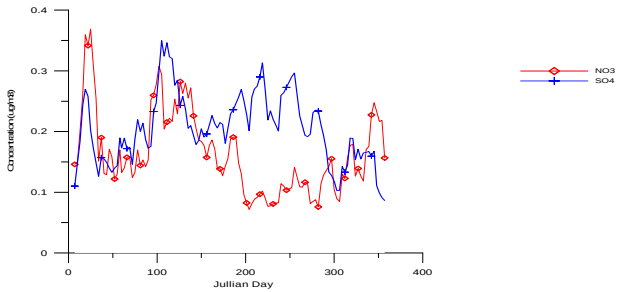
Cumulative Effects Public Comments

Name	Date	Message	Document Item
Deb Banton	7/5/2007	I have been concerned for many years about the air quality of the Four Corner's region because of the coal fired power plants in N.M. I attended two of the Four Corner's air quality forums in the past and was disturbed by their reports. As a nurse, I am especially concerned for the health of the Native Americans and other people who reside close to the power plants because of their incidence of lung disease. As a resident of La Plata canyon for 20+ years with a high mercury level, I am concerned about my own health and notice more air pollution, lack of visibility, every time I hike in the mountains. I believe for everyone's health, alternative sources of energy; e.g. solar, wind energy is a much better solution and would still serve as a revenue source to the Navajo nation. Desert Rock should not be built and the others should be phased out as planned many years ago or at least upgraded to standards that were set by the Clinton administration.	General Comment
Catherine Boyd	7/8/2007	We do NOT need another power plant in the 4 Corners. I notice the dirty air in this area all of the time and especially on weekends. Drive up from Albuquerque and see the air get dirtier. Also, go out from the 4 Corners and notice the beautiful blue skies as you progressively leave the area. I teach school and stress to my students they need to take care of the this planet earth because there is no spare earth. I would like to stress to everyone else that this needs to be done. Solar, wind and other energy sources should be used.	General Comment
Cindy Quigley	7/12/2007	It breaks my heart to think that another coal fired plant may be added to our "pristine" 4 corners area. Even in Pagosa Springs we have some hazy smog some days, and when driving south and west of Farmington, that horrible yellow-brown cloud can be seen for miles! I was shocked to see that poisonous cloud in Monument valley, and northwest Utah. It's all pervasive now so I can't imagine what it will be like with more coal -spewing plants. We must use non polluting energy sources for the health of all of us!	General Comment
BP	7/13/2007	The Task Force report presents data on the potential emission reductions for the Four Corners Power Plant and the San Juan Power Plant. The Cumulative Effects Work Group needs to evaluate potential power plant mitigation options that are presented in the report and develop a quantitative summary of all potential mitigations options which have technical merit. It is useful to place the emission reductions suggested for power plants in perspective to those developed for oil and gas sources. As stated in the Draft Report, for the Four Corners Power Plant the installation of presumptive BART could result in SO2 emission reductions from a minimum of 12,455 tons per year to a maximum of 19,927 tons per year. Similarly, NOx emission reductions could range from 13,651 tons per year to 57,118 tons per year. Since SO2 and NOx emissions are considered as having similar visibility impairment potential, the magnitude of the total emission reductions possibly affecting visibility could range from 26,106 to 77,045 tons per year. For the San Juan Power Plant using data presented in the Task Force Report, estimated SO2 emission reductions could be approximately 9,000 tons per year and NOx reductions could be approximately 11,000 tons per year. For this plant the combination of SO2 and NOx possible reductions of 20,000 tons per year might be achieved. The information contained in the Draft Report regarding possible emission reductions for this source is not as complete as for the Four Corners Plant and additional data should be developed and presented.	General Comment

Name	Date	Message	Document Item
		If the suggested emission reduction strategies were implemented at both plants, total SO2 and NOx emission reductions of visibility impairment pollutants could range from 46,106 tons per year to 97,046 tons per year. In addition, review of the emission data in the Draft Report indicates that at the Four Corners Power Plant NOx emissions are greater than SO2 emissions (Figure 2 FCPP Emission Trends). However, in 2003 SO2 emissions were further reduced so that the ratio of NOx to SO2 emissions increased. At the San Juan Power Plant prior to 1990, SO2 emissions were greater than NOx emissions while in 1999 SO2 and NOx emissions were equal (Figure 1 San Juan SO2 and NOx). After that time, SO2 emissions were less than NOx emissions. The trends in emissions at these facilities may be important in understanding the trends in the IMPROVE monitoring data. Engineering and economic feasibility studies need to evaluate the ability of the facilities to continuously achieve emission reductions in a cost effective manner. The potential emission reduction that could be realized with the installation of additional controls on power plants need to compared with the emission reductions reported by the Draft Task Force Report for oil and gas sources. The installation of NSCR on existing small engines in Colorado and New Mexico could result in emission reductions of approximately 10,244 tons per year. These emission reductions are only a small fraction of the reductions possible from power plants (minimum ratio of power plant reduction to oil and gas reductions 4.5 – maximum ratio of power plant reduction to oil and gas reductions 9.5).	
BP	7/13/2007	The Draft Task Force Report presents recommendations for mitigating emissions from drilling rig diesel engines. At the present time there is insufficient information regarding the level of emissions from these sources in the region. The Cumulative Effects Group should develop emission data regarding the magnitude of emissions in both Colorado and New Mexico and then develop estimates of potential emission reductions that could be achieved. The emission calculations should be based on site specific information that represents the length of time to drill a new well, engine loads and engine capacity. One important fact that needs to be considered is that the drilling rig engines are typically replaced at a frequency of every 5 years (replaced not rebuilt). This rate of turnover is very important because the engines are replaced with the required current control technology. This should be the baseline against which alternative mitigation options should be considered. It is recommended that the Cumulative Effects Group continue to analyze and evaluate emission reduction options for this source group.	General Comment
BP	7/13/2007	The following plots present selected years of rolling 5 data point averages of the SO4 and NO3 concentrations compared to Julian day for the IMPROVE data from Mesa Verde. Using a rolling 5 data point average provides some smoothing of the data but allows correlations between SO4 and NO3 to be observed. The plots for 1988 and 1990 indicate a large fraction of coincident peaks of SO4 and NO3. This is an important finding because it suggests that these events may result from coal fired sources because natural gas fired sources or mobile sources do not emit significant SO2. In addition, NO3 concentrations are smaller than SO4 concentrations. The data from 2002, 2003 and 2004 indicate that a change has occurred in the relationship of SO4 and NO3 measurements and that there is a very strong correlation of SO4 and NO3 events, again suggesting a coal fired source. However, in 2002, 2003 and 2004 NO3 concentrations are equal to or greater than SO4 concentrations. As mentioned in the power plant emission section, SO2 reductions began in 1999 and after that time NOx emissions were greater than SO2 emissions. This trend in changes in emissions is very consistent with the monitoring data and again suggests visibility impacts are likely from coal fired sources. This is a preliminary hypothesis that needs more evaluation and may explain why NO3 levels have been increasing at Mesa Verde.	General Comment

Name	Date	Message	Document Item
		If this finding is confirmed, it has important ramifications regarding improvement in air quality. This is the type of focused analyses that needs to be conducted before mitigation options are selected and implemented.  **1988 SO4 and NO3 Concentrations 5 Day Running Average** **Mesa Verde**	

Name	Date	Message	Document Item
		 1990 SO4 and NO3 concentrations 5 day running average  **2002 SO4 and NO3 Concentrations 5 Day Running Average Mesa Verde**	

Name	Date	Message	Document Item
		 **2003 SO4 and NO3 Concentrations 5 Day Running Average Mesa Verde**  **2004 SO4 and NO3 Concentrations 5 Day Running Average Mesa Verde**	
Jeanne Hoadley	7/11/2007	last paragraph before Suggestions for Future Work...should the reference be to Table 2 rather than Table 1?	2 - Overview of Work Performed

Name	Date	Message	Document Item
EPA Region 8	7/11/2007	Table 1 - Selective Catalytic Reduction (SCR) on Drilling Rig Engines: It is stated "that some data exists on drilling emissions. The State of Wyoming evaluated this technology based on a pilot study in the Jonah Field & concluded that is not a cost effective technology, but further analysis is needed." This paragraph references the cost analysis WY did for SCR on diesel rig engines, but does not provide or reference any information on what conditions and assumptions WY used in conducting this analysis. If possible the CE workgroup should obtain and review the WY analysis on SCR, in addition to other diesel control options WY analyzed. Table 1 - Follow EPA New Source Performance Standards (NSPS) for RICE: EPA suggests revising the Summary of Result first sentence "This proposed emission standard will become the baseline for new, **modified, and reconstructed** engines. Table 1 - Install Non Selective Catalytic Reduction (NSCR) on Rich Burn Engines for RICE. It is unclear in the Summary of Result what EPA performance standard is being referenced, and how the 4 Corners Task Force Interim Emissions Recommendations for Stationary RICE have been considered by the CE workgroup. The NSPS for spark ignition engines will apply to **new, modified, and reconstructed** units starting in January 2008. The 4 Corners Task Force Interim Emissions Recommendations for Stationary RICE notes that BLM/USFS, at the request of CO and NM, is currently requiring NSPS comparable emission limits on as a Condition of Approval for their Applications for Permits to Drill. The States' request was that BLM/USFS immediately establish in every Application for Permit to Drill (APD) a nitrogen oxide (NOx) limit of 2.0 grams per horsepower hour for all **new and replacement** engines less than 300 hp (excluding engines with horsepower less than 40). In addition, New Mexico and Colorado have requested that for all new and replacement engines greater than 300 hp, the BLM and the USFS establish in every APD a NOx limit of 1.0 gram per horsepower hour. EPA Region 8 formally supports both these requests from Colorado and New Mexico. It should also be noted that the Mitigation Option: Interim Emissions Recommendations for Stationary RICE section in the Draft Mitigation Options Report states that "BLM in New Mexico and Colorado are currently requiring these emission limits as a Condition of Approval for their Applications for Permits to Drill. These limits currently apply only to **new and relocated** engines ... (compressors assigned to the well APD)..." In developing assumptions for potential NOx reductions from this requirement in APDs, how did the CE workgroup determine, or assume, what percentage of the existing engines (compressors) in the 4 Corners area would be required to meet this requirement?	2 - Overview of Work Performed

Name	Date	Message	Document Item
ANL: Anand/Lazaro	7/15/2007	1. Given electric compression would shift emissions generated from NG compressor engines through use of electric engines to emissions from power generation (i.e., "the grid"), this option is clearly "cross-cutting." We recommend that the coordination with the Power Plant WG in the analysis of this option. 2. We were unable to reproduce the emission reduction numbers from the data provided in the analysis (tons/yr deltas provided in Table 4). Based on the data provided we calculate a total of 631 tons/yr reductions in NOx and SO2 based the 25 worst engines and the average power plant emissions in Table 3. 3. In course of installing electric compression to replace the natural gas fired compression engines, the analysis correctly assumes that the emission of pollutants will shift from the replaced compressor engines to increased electric load demand from the grid. In course of review of the Natural Resources Defense Council (NRDC) "Emission Data for the 100 Largest Power Producers", it appears that baseline average emission factors used for emission difference calculation are the national average emission factors for the identified owner utility companies (average of all plants, regardless of location or on which power grid). The electric power for electric compression will come from the Western Grid which draws power from generating stations in the western United States. Among the three electric power producers, Xcel is the largest producer with 81,283,493 MWhs capacity compare to 21,230,675 MWhs for both PNM and Tri-state. The baseline average emission factors based on national average emission factors of these three electric power producers have potential to distort the emission difference calculation because Xcel's power generation facilities in Minnesota, South Dakota, Texas, and Wisconsin are not supplying electricity to the Western Grid. A brief description of grid system is provided later in this document. A better measure of the effectiveness of this option would be the use of average NOx and SO2 emissions from Four Corners Generating Station and San Juan Generating Station. In case example case provided in the analysis, replacing 25 worst engines with total 2,701 hp in NM side with electric compression, will result in net NOx + SO2 reduction of 610 tons/year. A net NOx +SO2 reduction of approximately 20,000 tons/year can be achieved by replacing all rich burn engines (approximately 1,500 in NM inventory) emitting greater than 5 g/hp-hr. Although it may not be practical or economically feasible to replace all rich burn compressor engines with electric motors, further analysis of the locations/ configurations of existing compressor stations may reveal that conversion to electric is practical and makes sense. Factors like proximity to the electric grid, ROW, number of engines, are factors that would need to be evaluated. 4. The electricity for the electric compression in the San Juan area will be drawn from Western Interconnect or Grid. We recommend that a good approximation for baseline emission factors will be the averages of emission factors for the power plants supplying electricity to the Western Grid. The following steps can be taken to obtain the baseline average emission factors for the emission difference calculation: a. The average emission factors for fossil fuel powered power plants supplying electric power to the Western Grid can be calculated using the emission data from the EPA's CAMD inventory. The EPA's Clean Air Market Data (CAMD) (http://camddataandmaps.epa.gov/gdm/index.cfm) provides NOx, SO2, and CO2 emission as well as heat input for the Title IV power generating units.	4 - Mitigation Option: Install Electric Compression

Name	Date	Message	Document Item
		b. The net power generation by state by type of producer by energy source is available at the Energy Information Administration (EIA) website (http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html). c. A fraction between calculated average baseline emission factors for the Western Grid based on EPA data and the total power generation for the Western Grid obtained from EIA's website will used to obtain the average baseline emission factors for emission difference calculations. 5. The worst case NOx emissions from coal-fired plants is 4.5 lbs/MWh, which is equivalent to 1.5 g/hp-hr. The coal-fired plants produce a lot more NOx emissions than the gas field sources do: 160,264 tons/year compared to 38,632 tons/year. A 5% reduction of NOx emissions from the coal-fired plants is the same as a 21% reduction in NOx from gas field sources. 6. We recommend that the Task Force evaluate on-site lean-burn electric generators as an alternative power source for electric compression.	
Southern Ute Growth Fund	7/11/2007	The SUGF recommends further research and testing of this mitigation option to help determine the amount of emissions reduction that can be accomplished on a continual, reliable basis. If technology could be developed and maintained on a regular basis, this option could prove to be valuable in retrofitting existing rich burn units.	5 - Mitigation Option: Use of NSCR for NOx Control on Rich Burn Engines
EPA Region 8	7/11/2007	In the section Mitigation Option: Use of NSCR for NOx Control on Rich Burn Engines it is stated in the Assumptions (p. 13): "Currently, recent EIS RODs in Colorado and New Mexico require performance standards for new engines that will accelerate the implementation of the 2008 and 2010 federal NSPS for non road engines." The term "replacement" is not used, only "new" engines. What is the CE workgroups understanding related to what type of engines would fall under the replacement category, and was this type of engine considered in the assumptions as being retrofitted to meet the interim recommendation of 2 g/hp/hr? Engine Size < 100 hp Case 1 (p. 14): It is stated that "it was assumed that NSCR for this situation would reduce NOx emissions by 50 percent in Colorado and New Mexico and would result in a NOx emission factor of 6.7 g/hp-hr in Colorado and 8.0 g/hp-hr in New Mexico." What is the basis for this assumption? The 2 g/hp-hr interim recommendation for new and replacement engines 300 hp and less (excluding engines less than 40 hp) has been in place since '05, which is almost 3 years ahead of the NSPS implementation date. Does the CE Workgroup have any information on how much impact this interim recommendation, as implemented through BLM/USFS APDs, has had on the average NOx emission factor from the current engine fleet in the 4 Corners area. Tables 6 and 7: Can some narrative be added that explains how emissions reductions are calculated and what each column in the tables represents? Why is table 6 (CO) different from table 7 (NM)? It is unclear how some of the emission reduction values have been calculated in tables 6 and 7. For example, in table 6 why is the emission reduction for < 100 Hp engines 130 TPY instead 143 TPY (50% x 286 TPY)?	5 - Mitigation Option: Use of NSCR for NOx Control on Rich Burn Engines

Name	Date	Message	Document Item
ANL: M. Lazaro/R. Cole	7/12/2007	1. Test data on small two-stroke NSCR retrofitted engines (Ajax DP-115) show NSCR can achieve large NOx emission reductions between 79% and 93% (Chapman, 2004a). On four stroke engines Chapman (2004b) indicates that "these catalyst systems reduce NOX emissions by over 98 percent, while reducing VOC by 80 percent and carbon monoxide by over 97 percent. NOx levels in the range of 0.1 to 1.0 g/bhp-hr have been achieved." Although this is consistent with the statement in the Draft Report that NSCR can achieve NOx emissions of less than 2 g/hp-hr, tighter control levels can certainly be achieved in retrofitting rich burn engines with a well controlled NSCR system. 2. Not all rich-burn engines would need to be retrofitted to NSCR to achieve the reductions postulated in the Draft Report. For example, if 57% of the under-100-hp engines in New Mexico were retrofitted with NSCR, which achieves less than 2 g/hp-hr NOx emissions (this is a conservative number, since NOx emissions that are well under 1 g/hp-hr are possible), then the overall emissions rate for that class of engine would decrease from 16 g/hp-hr to 8 g/hp-hr. According to Table 7 in the Draft Report, this would mitigate 6337 tons/yr of NOx (6694 tons/yr with growth). Since only 57% of the engines in this classification would need to be retrofitted, a retrofit kit would need to be developed only for the most common engine model (or a few models, at most.) This would save the expense of engineering development for engine models that have only a few examples represented in the Four Corners area and would concentrate the engineering effort where it would do the greatest amount of good. If more that 57% of the engines were controlled at the 2 g/hp-hr level, then more that 6337 tons/yr of NOx would be mitigated, but the incremental cost per tons/yr of NOx would be higher than that of the first 6337 tons/yr. It should also be noted that if the 57% of engines with NSCR controlled NOx at the 1 g/hp-hr rather than 2 g/hp-hr, 6773 tons/yr of NOx world be mitigated. This is an additional 436 tons/yr. A number of issues are identified with the use of NSRC on small engines. All of these issues, including ammonia formation, can be eliminated or minimized through use of a NSCR retrofit package that includes all the right components. The appropriate NSCR retrofit kit should include: - A 3-way catalytic converter - Exhaust oxygen sensor - Replace existing carburetor with a controllable air/fuel ratio (AFR) controller device. The ratio of an engine's actual AFR to the stoichiometric AFR for the fuel being used is referred to as the Lambda parameter. To ensure that exhaust bound O2 comprises no more that 0.5% (by volume) of the total engine exhaust, rich burn engines operate at λ's of between 0.988 and 0.992 (Chapman, 2004b). (For engines burning clean, dry natural gas, the air to fuel ratio (AFR) for stoichiometry is ~16.1:1, Chapman, 2004a). - Computerized control using feedback from the exhaust oxygen sensor to control the air/fuel ratio λ's of between 0.988 and 0.992 with the retrofitted NSCR system. - Exhaust gas recirculation (EGR) and controllable ignition timing could also be included and controlled by the same computer. Both EGR and retarded ignition timing reduce engine-out NOx emissions and enhance the effectiveness of the catalyst. Retarded ignition timing also has the effect of increasing exhaust temperature, which will improve the effectiveness of the catalyst at light engine loads. Although considerable engineering effort is required to develop the retrofit kit, it needs to be done for only one engine model or a few engine	5 - Mitigation Option: Use of NSCR for NOx Control on Rich Burn Engines

Name	Date	Message	Document Item
		models, at most. In the 3rd parg. under engines < 100 hp, it states; "Also, research indicates that if the AFR drifts off the optimal setting, then NOx emissions may be converted (on an equal basis) to ammonia. If this occurs within the discharge plume of an engine, it may accelerate the conversion of NOx emissions into particulate nitrate. This is the reason that the carburetor must be replaced with a more accurate AFR controller having feedback from an exhaust oxygen sensor. With such a system, accurate AFR control is achieved, and generation of ammonia is not an issue. _____ Chapman, K., 2004a, Report 6: Cost-Effective Reciprocating Engine Emissions Control and Monitoring for E&P Field and Gathering Engines, Technical Progress Report, DOE Award DE-FC26-02NT15464, Kansas State University, August Chapman, K., 2004b, Report 4: Cost-Effective Reciprocating Engine Emissions Control and Monitoring for E&P Field and Gathering Engines, Technical Progress Report, DOE Award DE-FC26-02NT15464, Kansas State University, January	
ANL: M. Lazaro/R. Cole	7/12/2007	The assumption of 50% reduction of NOx in the Draft Report is too pessimistic or small. Other information indicates that NOx reduction greater than 90% is achievable. Another report indicated 95.9% NOx reduction on a 320 kW (430 hp) natural-gas fueled engine. The same report gave costs of $2,205-$3,684 per ton of NOx removed. This is considerably less than the $10,300 per ton of NOx removed indicated in the Draft Report. Another report indicated that the cost of SCR on reciprocating natural-gas engines varied from $30-$250 per horsepower with no correlation to engine size. Considering that the date of the fourth report is 1990, one reason for the variation in cost may be lack of experience on the part of some installers. Using the same methodology that was used in the Draft Report, but allowing a 90% NOx reduction on new engines instead of 50% gives a reduction of 1789 tons/year (16.5% reduction of overall NOx) in Colorado and a reduction of 2015 tons/year (4.6% reduction of overall NOx in New Mexico. The 90% NOx reduction should be achievable with good operation and maintenance practice in light of the 95.9% NOx reduction already achieved in the field. These figures were for new engines greater than 500 hp. Since the reported engine was smaller than 500 hp, the same calculation was performed for new engines greater than 300 hp. These gave a reduction of 2,109 tons/year (19.5%) in Colorado and 2502 tons/year (5.8%) in New Mexico. The engines with SCR would have NOx emissions of about 0.1 g/hp-hr. _____ 1. Jim McDonald and Xavier Palacios, "Compressor Tech 2: SCR for Gaz de France," Miratech Corporation, Tulsa, OK, December 1, 2002. 2. Johnson Matthey Corp., "Maximum NOx Control for Stationary Diesel and Gas Engines," brochure number "jm_brochure_scr_062306b.pdf". 3. Ravi Krishnan, RJM Corp., "Urea-based SCR technology achieves 12 ppm NOx on natural gas engine," PennWell Power Group Online Article available at http://pepei.pennet.com/Articles/Article_Display.cfm?ARTICLE_ID=156191, October 1, 2002. 4. G.S. Shareef and D.K. Stone, "Evaluation of SCR NOx controls for small natural gas-fueled prime movers. Phase 1. Topical Report," report number PB-90-270398/XAB; DCN-90-209-028-11; GRI-5089-254-1899,	6 - Mitigation Option: Use of SCR for NOx Control on Lean Burn Engines

Name	Date	Message	Document Item
		Radian Corp., Research Triangle Park, NC, July 1, 1990.	
Mike Lazaro/Roger Cole	7/12/2007	The first paragraph of the section on Next Generation RICE Stationary Technology in the Draft Report does not give adequate weight to the importance of next generation technology. As emissions regulations become tighter (e.g., 0.2 g/hp-hr NOx in 2010), those limits will become increasingly difficult to meet with existing technology. Continuing research on advanced technologies is necessary to ensure than ever tighter limits in the future can be met. Three of the technologies listed below, NOx trap catalysts, laser ignition, and HCCI, are close to meeting the 0.2 g/hp-hr limit by themselves. Two of the technologies, laser ignition and HCCI, may be able to meet the 0.2 g/hp-hr limit without aftertreatment. With aftertreatments they may be able to meet an even lower limit. NOx trap catalysts are an aftertreatment that offers the same performance as SCR, but with potentially lower cost. Air separation membranes may be used in combination with other technologies to outperform the 0.2 g/hp-hr limit. NOx trap catalysts are similar in performance to SCR, that is they can reduce more than 90% of the engine-out NOx to achieve less than 1 g/hp-hr NOx emissions.[1] The estimates of NOx abatement used in the Cumulative Effects SCR section of the draft report may be used as a guide to the abatement potential of NOx trap catalysts. The cost is expected to be less than that of SCR because ammonia or urea is not used as a reductant. Instead, some of the fuel is used as a reductant. The increase in fuel consumption may be up to 8%, but is typically about 4%. Air separation membranes used to deplete oxygen from the intake air have an effect on NOx emissions that is similar to that of exhaust gas recirculation (EGR) in rich-burn and diesel engines. Combined with ignition retardation, a reduction in engine-out NOx of up to 40% can be expected.[2,3] For engines in the 300-500 hp range, air separation membranes with ignition retard could reduce overall NOx emissions to 2 g/hp-hr in both Colorado and New Mexico. For the 100-300 hp range, these technologies could reduce overall NOx emissions from 16.3 to 10 g/hp-hr in Colorado and from 12.5 to 7.5 g/hp-hr in New Mexico. For engines under 100 hp, the technologies could reduce overall NOx emissions from 13.4 to 8 g/hp-hr in Colorado and from 16 to 9.6 g/hp-hr. Laser ignition may be able to reduce NOx emissions by as much as 70% in lean burn engines.[4] However, in the reference cited, the baseline emissions for the engine with spark ignition were higher than the emissions that are currently achievable with lean burn engines. Additional development and testing will be required to verify the reduction of NOx emissions. There is little information in the literature about lean NOx catalysts used with lean burn natural gas engines. Information about lean NOx catalysts used with diesel engines indicates NOx reductions of 10-40% depending on whether fuel is used as a reductant.[5,6] NOx reductions for lean burn natural gas engines is expected to be similar. Although researchers are attempting to improve the conversion efficiency of lean NOx catalysts, their current low performance makes them unsuitable for the short term. Only a few experimental measurements of NOx from homogeneous-charge compression-ignition (HCCI) engines have been reported. The measurements are typically reported as a raw NOx meter measurement in parts per million rather than being converted to grams per horsepower-hour. Dibble reported a baseline measurement of 5 ppm when operated on natural gas.[7] Green reported NOx emissions from HCCI-like (not true HCCI) combustion of 0.25 g/hp-hr.[8] Whether HCCI technology can be applied to all engine types and	11 - Mitigation Option: Next Generation Stationary RICE Technology

Name	Date	Message	Document Item
		sizes is not known. In addition, the ultimately achievable NOx emissions from such engines is not known. However, if all reciprocating engines could be converted to HCCI so that the engines produce no more than 0.25 g/hp-hr, then the overall NOx emissions reduction would be 80% in both Colorado and New Mexico using the calculation methodology of the SCR mitigation option. _____ 1 James E. Parks II, Douglas Ferguson III, and John M. E. Storey, "NOx Reduction With Natural Gas for Lean Large-Bore Engine Applications Using Lean NOx Trap Aftertreatment." Oak Ridge National Laboratory, 2360 Cherahala Blvd., Oak Ridge, TN 37932. 2 K. Stork and R. Poola, "Membrane-Based Air Composition Control for Light-Duty Diesel Vehicles: A Cost and Benefit Assessment," Report Number ANL/ESD/TM-144, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439, October 1998. 3 Joe Kubsh, "Retrofit Emission Control Technologies for Diesel Engines," NAMVECC 2003, Manufacturers of Emission Controls Association, www.meca.org, Chattanooga, TN, November 4, 2003. 4 B. Bihari, S. B. Gupta, R. R. Sekar, J. Gingrich, and J. Smith, "Development of Advanced Laser Ignition System for Stationary Natural Gas Reciprocating Engines," ICEF2005-1325, ASME-ICE 2005 Fall Technical Conference, Ottawa, Canada, 2005. 5 Joe Kubsh, op.cit. 6 Carrie Boyer, Svetlana Zemskova, Paul Park, Lou Balmer-Millar, Dennis Endicott, and Steve Faulkner, "Lean NOx Catalysis Research and Development", Caterpillar Inc., presented at the 2003 Diesel Engine Engineering Research Conference. 7 Robert Dibble, et al, "Landfill Gas Fueled HCCI Demonstration System," CA CEC Grant No: PIR-02-003, Markel Engineering Inc. 8 Johney Green, Jr., "Novel Combustion Regimes for Higher Efficiency and Lower Emissions," Oak Ridge National Laboratory, "Brown Bag" Luncheon Series, December 16, 2002.	
Southern Ute Growth Fund	7/11/2007	The SUGF recommends further examination of the above listed mitigation options as particulates associated with each option contribute to local visibility issues.	12 - Mitigation Option: Automation of Wells to Reduce Truck Traffic 13 - Mitigation Option: Reduced Truck Traffic by Centralizing Produced Water Storage Facilities