these procedures actually have been found to increase noise because of power applications needed to arrest high sink rates.

Conclusion: Because these procedures erode safety margins and are of little practical noise abatement benefit, they do not deserve further consideration at RNO.

Reverse Thrust Restrictions

Thrust reversal is routinely used to slow jet aircraft immediately after touchdown. This is an important safety procedure which has the added benefit of reducing brake wear. Limits on the use of thrust reversal can reduce noise impacts off the sides of the runways, although they would not significantly reduce the size of the noise contours. Enforced restrictions on the use of reverse thrust, however, are not considered fully safe.

Discussion: Given the location of noise-sensitive uses in the RNO vicinity, a restriction on thrust reversal may produce some benefits. However, reverse thrust restrictions tend to erode landing safety margins, increase runway occupancy time, and increase wear on aircraft. Other mitigation measures, such as noise barriers, would offer similar benefits without creating safety concerns.

Conclusion: Mandated limitations on the use of reverse thrust are inadvisable at RNO because of the reduced safety margins and the potential for alternative mitigation measures. As an operational flight procedure with a direct effect on safety, decisions about whether to use reverse thrust should be left to the discretion of pilots. Therefore, this measure does not merit further consideration.

AIRPORT REGULATIONS

Federal Aviation Regulation (F.A.R.) Part 150 requires that, in developing Noise Compatibility Programs, airports study the possible implementation of airport use restrictions to abate aircraft noise. [See F.A.R. Part 150, B150.7(b)(5).] The courts have recognized the right of airport proprietors to reduce their liability for aircraft noise by imposing restrictions which are reasonable and do not violate contractual agreements with the FAA conditioning the receipt of federal aid. (These are known as "grant assurances.") In addition, constitutional prohibitions on unjust discrimination and the imposition of undue burdens on interstate commerce must be respected. The restrictions must also be crafted to avoid infringing on regulatory areas preempted by the federal government. Finally, the regulations must be evaluated under the requirements of F.A.R. Part 161.

Airport noise and access restrictions may be proposed by an airport operator in its F.A.R. Part 150 Noise Compatibility Program. The FAA has made it clear that the approval of a restriction in an F.A.R. Part 150 document would depend on the noise abatement benefit of the restriction at noise levels of 65 DNL or higher. Even if the FAA should accept a noise restriction as part of an F.A.R. Part 150 Noise Compatibility Program, the requirements of F.A.R. Part 161 would

still need to be met before the measure could be implemented.

F.A.R. Part 161

In the Airport Noise and Capacity Act (ANCA) of 1990, Congress not only established a national phase-out policy for Stage 2 aircraft above 75,000 pounds, it also established analytical and procedural requirements for airports desiring to establish noise or access restrictions on Stage 2 or Stage 3 aircraft. Regulations implementing these requirements are published in F.A.R. Part 161.

F.A.R. Part 161 requires the following actions to establish a local restriction on Stage 2 aircraft:

- An analysis of the costs and benefits of the proposed restriction and alternative measures.
- Publication of a notice of the proposed restriction in the Federal Register and an opportunity for public comment on the analysis.

While implementation of a Stage 2 aircraft operating restriction does not require FAA approval, the FAA does determine whether adequate analysis has been done and all notification procedures have been followed.

For restrictions on Stage 3 aircraft, Part 161 requires a much more rigorous analysis as well as final FAA approval of the restriction. Before approving a local Stage 3 noise or access restriction, the FAA must make the following findings:

- The restriction is reasonable, non-arbitrary, and non-discriminatory.
- The restriction does not create an undue burden on interstate or foreign commerce.
- The restriction maintains safe and efficient use of navigable airspace.
- The restriction does not conflict with any existing federal statute or regulation.
- The applicant has provided adequate opportunity for public comment on the proposed restriction.
- The restriction does not create an undue burden on the National Aviation System (NAS).

Based on FAA's interpretations of Part 161, the regulations do not apply to restrictions proposed only for aircraft under 12,500 pounds. Because these light aircraft, which include small, single engine aircraft, are not classified under Part 36 as Stage 2 or 3, the FAA has concluded that the 1990 Airport Noise and Capacity Act was not intended to apply to them. (See *Airport Noise Report*, Vol. 6, No. 18, September 26, 1994, p. 142.)

Very few Part 161 studies have been undertaken since the enactment of ANCA. **Table 5B** summarizes the studies that have been done to date.

TABLE 5B
Summary of F.A.R. Part 161 Studies

Airport	Year		Cost	Proposal, Status
	Started	Ended		
Aspen-Pitkin County Airport, Aspen, Colorado	N.A.	N.A.	N.A.	The study has not yet been submitted to FAA.
Kahului Airport, Kahului, Maui, Hawaii	1991	1994	$50,000 (est.)	Proposed nighttime prohibition of Stage 2 aircraft pursuant to court stipulation. Cost-benefit and statewide impact analysis found to be deficient by FAA. Airport never submitted a complete Part 161 Study. Suspended consideration of restriction.
Minneapolis-St. Paul International Airport, Minneapolis, Minnesota	1992	1992	N.A.	Proposed nighttime prohibition of Stage 2 aircraft. Cost-benefit analysis was deficient. Never submitted a complete Part 161 study. Suspended consideration of restriction and entered into negotiations with carriers for voluntary cooperation.
Pease International Tradeport, Portsmouth, New Hampshire	1995	N.A.	N.A.	Have not yet submitted a Part 161 study for FAA review.
San Francisco International Airport, San Francisco, California	1998	1999	$200,000	Proposing extension of nighttime curfew on Stage 2 aircraft over 75,000 pounds. Started study in May 1998. Submitted to FAA in early 1999 and subsequently withdrawn.
San Jose International Airport, San Jose, California	1994	1997	Phase 1 - $400,000 Phase 2 - $5 to $10 million (est.)	Study undertaken as part of a legal settlement agreement. Studied a Stage 2 restriction. Suspended study after Phase 1 report showed costs to airlines at San Jose greater than benefits in San Jose. Never undertook Phase 2, systemwide analysis. Never submitted study for FAA review.
Burbank-Glendale-Pasadena Airport	2000	Ongoing	Phase 1 - $1 million (est.)	Proposed curfew restricting all aircraft operations from 10:00 p.m. to 7 a.m.
Naples Municipal Airport Naples, Florida	2000	2000	Currently $730,000 Expect an additional cost of $1.5 to $3.0 million in legal fees due to litigation.	Enactment of a total ban on Stage 2 general aviation jet aircraft under 75,000 pounds (the airport is currently restricted to aircraft under 75,000 pounds). Stage 2 ban currently deferred due to FAA request for additional analysis. Currently in litigation due to suits from numerous organizations and individuals. Airport may have to repay all previous federal funding received for airport projects.

N.A. - Not available.

Sources: Telephone interviews with Federal Aviation Administration officials and staffs of various airports.

Regulatory Options

Regulatory options discussed in this section include the following:

- Nighttime curfews and operating restrictions.
- Landing fees based on noise or time of arrival.
- Airport capacity limitations based on relative noisiness.
- Noise budgets.
- Restrictions based on aircraft noise levels.
- Restrictions on touch-and-go's or multiple approaches.
- Restrictions on engine maintenance run-ups.

Nighttime Curfews And Operating Restrictions

Curfews and operating restrictions can often be effective methods for reducing aircraft noise exposure around an airport. Since noise is commonly assumed to be most annoying in the late evening and early morning hours, curfews are usually aimed at restricting nighttime operations. However, curfews have economic impacts on airport users, those providing airport-related services, and the community as a whole. Other communities also may be impacted through curtailment of service.

There are essentially three types of curfews or nighttime operating restrictions: (1) closure of the airport to all arrivals and departures (a full curfew); (2) closure to departures only; and (3) closure to arrivals and departures by aircraft exceeding specified noise levels.

Discussion: The time during which nighttime restrictions could be applied varies. The DNL metric applies a 10 decibel penalty to any noise event occurring between 10:00 p.m. and 7:00 a.m. That period could be defined as a curfew period. A shorter period, corresponding to the very late night hours, say midnight to 6:00 a.m., could also be specified.

Full Curfews: While full curfews can totally resolve concerns about nighttime aircraft noise, they can be indiscriminately harsh. Not only would the loudest operations be prohibited, but quiet operations by light aircraft also would be banned by a full curfew. Full curfews also deprive the community of the services of some important nighttime airport users. In fact, according to the airport's consolidated air carrier flight schedule, it is estimated that such a restriction would affect 24 commercial flights scheduled to arrive or depart between 10:00 p.m. and 7:00 a.m. Of course, full curfews would restrict access to the airport by Stage 3 aircraft. Thus, a full Part 161 analysis and FAA approval would be required prior to implementation.

Important economic reasons drive nighttime airport activity. Early morning departures are often attractive for business travelers who wish to reach their destinations with a large part of the workday ahead of them. Not only is this a personal convenience, but it can result in a significant savings in the cost of travel by reducing the need for overnight stays. Accordingly, early morning departures are often very

popular, and the airlines have attempted to meet this demand. Similarly, late night arrivals are important in allowing travelers to return home without incurring the costs of another night away. Air carriers also need to position their aircraft so they are ready for the next day's schedule. This tends to mandate nighttime arrivals. Since RNO is the only commercial service airport serving northern Nevada and a portion of California, economic impacts caused by restrictions at the airport could affect the entire region.

Different, but equally compelling, reasons encourage cargo carriers and courier companies to operate in the evening and at night. Cargo is collected during the business day. It is shipped to a hub facility in the evening or at night where it is sorted and, in the case of package express service, delivered to its destination the next business day. Bulk cargo companies work essentially the same way, although where speed is not of paramount importance, the collection and delivery functions may involve more use of surface transportation. Modern air cargo service cannot operate without nighttime access to airports.

Prohibition of Nighttime Departures: The prohibition of nighttime departures would allow aircraft to return home but would prohibit departures, which are generally louder than arrivals. Although somewhat less restrictive, this would have similar impacts at RNO as a full curfew. It would interfere with air carriers in their attempts to schedule early morning departures for the business travel market. At RNO, this would affect approximately 13 commercial departures scheduled between the hours of 10:00 p.m. and 7:00 a.m. In addition, such a curfew would greatly affect air cargo carriers.

As with a full curfew, a nighttime prohibition on departures would restrict access to the airport by Stage 3 aircraft. This would require a full Part 161 analysis and FAA approval of the restriction before it could be implemented.

Nighttime Restrictions Based on Aircraft Noise Levels: Nighttime operating restrictions can be designed to apply only to those aircraft which exceed specified noise levels. If it is to be effective in reducing the size of the DNL noise contours, the restricted noise level would have to be set to restrict the loudest, most commonly used aircraft at the airport. Representative aircraft that could be involved would be the B-727 hushkit, B-737 hushkit, and the MD-80. At RNO, this would affect 10 arriving and departing air carrier aircraft. This number does not include aircraft currently used by air cargo operations at RNO. Because these aircraft all meet Stage 3 noise levels, F.A.R. Part 161 would require a detailed analysis and approval by the FAA. In setting the restricted noise level, care would need to be taken that the restriction did not fall too heavily upon one carrier. Otherwise, charges of unjust discrimination could be levied.

Conclusion: Curfews and nighttime operating restrictions can be an effective way to reduce the size of DNL noise contours around an airport. Because of the extra 10 decibel weight assigned to nighttime noise, removing a single nighttime operation is equivalent to eliminating 10 daytime operations. The

effect on the noise contours can be significant.

A particularly troubling aspect of curfews and nighttime operating restrictions is their potential adverse effects on local air service and the region's economy. This is especially compelling since RNO is the only commercial service airport operating in the Reno area. Such a restriction could potentially affect up to 24 air carrier aircraft in addition to those used by air cargo operations. Additionally, implementation of nighttime restrictions can be costly, problematic, and require the completion and subsequent FAA approval of a Part 161 Study. Therefore, this measure does not warrant further consideration.

Noise-Based Landing Fees

Commercial airports typically levy landing fees on aircraft to raise revenue for airport operations and maintenance. Fees are typically based on aircraft gross weight. Landing fees can also be based on aircraft noise levels and the time of day of landings. Thus, arrivals at night by loud aircraft would be charged the highest fees, while arrivals during the day by quiet aircraft would be charged the smallest.

If noise-based landing fees are set high enough, they might encourage airlines to bring quieter aircraft into the airport. Noise-based landing fees that are set high enough to affect air carrier operations would almost certainly be subject to legal challenge. The system could be vulnerable to attack as an undue burden on interstate commerce. The fee structure could also possibly be attacked as discriminatory if its affect was to single out one, or a few, carriers for especially strict treatment. In practice, however, landing fees are such a small part of the total operating costs of an airline that increases in fees or noise-based surcharges may become merely an irritant to the carrier.

Before the adoption of the ANCA in 1990, noise-based landing fees were often considered a way to encourage air carriers to convert to Stage 3 aircraft. Under ANCA, full conversion of aircraft over 75,000 pounds to Stage 3 standards was mandated by the year 2000. Therefore, the traditional objective of noise-based landing fees is no longer relevant. Of course, different kinds of Stage 3 aircraft produce different levels of noise. B-727s and DC-9s equipped with Stage 3 hush kits, for example, are louder than B-737-300s and A-320s. In theory, a system of noise-based landing fees could be used to attempt to encourage carriers to convert to the quietest Stage 3 aircraft. It is questionable how effective this could be in practice. An air carrier's fleet composition is dictated by many variables, including: aircraft purchase, financing, and leasing costs; operating and maintenance costs; air and maintenance crew training requirements; manufacturer support; and marketing strategy. Whether one airport can exert enough leverage through noise-based landing fees to influence aircraft acquisition and route assignment decisions is questionable.

If landing fees cannot be set high enough to have a demonstrable effect on airline behavior, noise-based fee surcharges can still be a reasonable way to raise money for financing noise abatement activities. This does not appear to be necessary at RNO, however, since adequate sources of local funding are available.

Discussion: Landing fees are typically set by the terms of an airline's lease with the airport. Thus, fees could only be adjusted at the time leases came up for renewal, even if the AAWC did establish a noise-based landing fee.

Noise-based landing fees are considered airport noise restrictions under F.A.R. Part 161. A Part 161 analysis would be required before such a fee system could be implemented. Any fee structure that would place a noise surcharge on Stage 3 aircraft would require FAA approval prior to implementation.

Conclusion: A noise-based landing fee system intended to provide strong incentives for carriers to convert their fleets to quieter aircraft is not practical and is vulnerable to legal challenges. A noise-based landing fee surcharge intended to raise revenue for noise mitigation activities is not considered necessary. The airport has other potential sources of revenue such as PFC's which can be used to provide funding for noise mitigation projects. Noise-based landing fees will not receive additional consideration.

Capacity Limitations

Capacity limitations have been used by some severely impacted airports to control cumulative noise exposure. This kind of restriction would impose a cap on the number of scheduled operations. This is only an imprecise way to control aircraft noise. For one thing, unscheduled operations would not be subject to the limit. In addition, the limit on scheduled operations actually provides no incentive for conversion to quieter aircraft. Rather, if passenger demand is increasing, it would encourage airlines to convert to larger aircraft, which often (but not always) tend to be noisier than smaller aircraft in the same Part 36 stage classification.

The implementation of capacity limitations would entail the allocation of operating slots among air carriers, an ongoing process which would likely require additional airport staff to deal solely with airline negotiations for operating positions. The system would have to provide some allowance for entry by new carriers to avoid being found to be an illegal restraint of trade.

Discussion: A cap on operations would not necessarily provide significant noise benefits. The forecast noise contours presented in Chapter Three provide an example. A comparison of the noise contours for forecast 2005 conditions and 2010 conditions (Table 3H on page 3-18 of the Noise Exposure Maps document) shows only a slight increase in the size of the 65, 70, and 75 DNL noise contours from 2005 to 2010 to the north. During that period, however, the number of annual aircraft operations is projected to increase from 179,862 to 201,762 (Table 3C on page 3-7 of the Noise Exposure Maps document).

Conclusion: Airport capacity limitations intended to control noise are too

imprecise to guarantee effectiveness and are unlikely to achieve significant noise reductions. They can also limit air service to the community, interfering with the needs of the local economy. They can also be difficult and expensive to administer. Since they inevitably would restrict access to the airport by Stage 3 aircraft, capacity limitations would be subject to Part 161 analysis and approval by the FAA. Airport capacity restrictions, therefore, do not merit additional analysis.

Noise Budgets

In the late 1980s, noise budgets gained attention as a potential noise abatement tool. After the enactment of the Aviation Noise and Capacity Act (ANCA) of 1990, mandating the retirement of Stage 2 aircraft over 75,000 pounds, interest in noise budgets waned. Noise budgets are designed to limit airport noise and allocate noise among airport users. The intent is to encourage aircraft operators to convert to quieter aircraft or to shift operations to less noise-sensitive hours. Before ANCA, the intent was to encourage conversion to Stage 3 aircraft and to discourage the use of Stage 2 aircraft.

While noise budgets can be designed in many different ways, six basic steps are involved. First, the airport must set a target level of cumulative noise exposure, usually expressed in DNL, which it intends to achieve by a certain date. Second, it must determine how to express that overall noise level in a way that would permit allocation among airport users. Third, it must design the allocation system. Fourth is the design of a monitoring system to ensure that airport users are complying with the allocations. Fifth is the establishment of sanctions for carriers that fail to operate within their allocations. Sixth, the system should be fine-tuned based on actual experience. The only simple step in this process is the first, setting a goal. From that point, it becomes increasingly complex.

Discussion: Different approaches can be used to define noise in a way which permits allocation. It is possible to use the DNL metric, or a variant, for this purpose. This has some advantages in that the FAA's Integrated Noise Model (INM) can be easily used to derive DNL levels attributable to the average daily operations of the various airport operators. The INM database can be used to establish a basis for noise allocations based on aircraft type. An alternative is to use the effective perceived noise level (EPNL) metric. This is the metric used to certify aircraft noise levels for compliance with F.A.R. Part 36. Noise levels of various aircraft expressed in EPNL are published in FAA Advisory Circulars 36-1E and 36-2C. EPNL values for the aircraft used by each operator on an average day could be summed to define the total noise attributable to the operator.

The third step, the design of the allocation system, is the most difficult and the least subject to fair and objective definition. The allocations can be handled in different ways. They could be auctioned, but without careful controls this could cause serious problems. It could give the financially stronger carriers the opportunity to buy extra noise allocations for purposes of speculation or restraint of competition. Another way to allocate the noise would be through a lottery. A drawback with

both of these methods is that they would not recognize past operating histories. It is also important that any allocation system include provisions for the entry of new carriers in order to have any chance of being legally permissible.

An allocation system based on the recent operating histories of each airline would probably be the fairest approach, but it would not be problem-free. To be as fair as theoretically possible, the allocation should be based on each carrier's contribution to existing noise levels at the airport and its past performance in helping to reduce that noise. If the allocation system is based only on current noise contribution, the carriers that have made significant investments in converting their fleets will be penalized in comparison with those which have not. The noisier airline, for example, could conceivably be given a competitive advantage because, if they were willing to convert to quieter aircraft, they would be able to increase their number of flights while still reducing their overall noise output. Carriers can also argue that their corporate aircraft operating procedures result in less noise than the operating procedures of their competitors and that this should be recognized in the noise allocation system.

After establishing the initial allocation system, it would be necessary to develop a schedule of declining noise allocations to each carrier in order to reach the overall noise reduction goals of the program. Each carrier would have the flexibility to develop scheduling at any time of the day with any aircraft type, so long as its allocation is not exceeded. The use of quieter aircraft or operations during less noise-sensitive hours would result in increased flights per allocation.

The fourth step involves monitoring compliance with the noise allocations. Any monitoring system will require extensive bookkeeping. The simplest method would involve the monitoring of aircraft schedules. Total noise contribution by carrier would be summed for the reporting period based on the activity during the reporting period. Noise levels for each flight would be based on the certificated noise level, or the INM data base noise level, for each aircraft. While this system would require large amounts of staff time to administer, it would be relatively simple to computerize and would have the advantage of enabling carriers to plan their activities with a clear understanding of the noise implications of their decisions.

A theoretically more precise method of compliance monitoring, but a more expensive and complex method, would be to monitor actual aircraft noise levels. Actual noise from each aircraft operation would be recorded for each operator. The advantage of this approach is that it would be based on actual experience. A significant disadvantage, however, is that it could be quite difficult for carriers to make predictions about the noise impact of their scheduling decisions. Many variables influence the noise occurring from any particular aircraft operation, including the weather, pilot technique, and air traffic control instructions. In addition, RNO would have to purchase a monitoring and flight tracking system.

The fifth step is to establish a system of fines or other sanctions to levy against carriers which fail to operate within their assigned noise allocations. To be effective, the sanctions should be severe enough to provide a strong incentive to cooperate with the program.

In an era where all aircraft weighing more than 75,000 pounds are Stage 3, it is difficult to imagine how a noise budget could promote significant noise reduction without reducing air service in the community. While some Stage 3 aircraft are louder than others, some carriers operate with fleets almost completely composed of among the quietest Stage 3 aircraft. Depending on the noise allocation and the reduction target assigned to such a carrier, they might be able to meet the target only by eliminating flights.

Conclusion: Noise budgets are complex methods of promoting airport noise reduction. They are particularly vulnerable to attack on grounds of discrimination and interference with interstate commerce. Noise budgets are extremely difficult to design in a way that will be seen as fair by all airport users and are likely to be quite expensive to develop. Negotiations on noise budget design and noise allocations are likely to be long and contentious and would require the assistance of noise consultants and attorneys. The costs of administering the system also would be substantial. The bookkeeping requirements are complex and additional administrative staff would definitely be required.

At RNO, a noise budget does not appear to be a practical option. The process would be long, expensive, and contentious. Its potential for delivering real and substantial improvements in the local airport noise environment is questionable and will not be discussed further.

Restrictions Based On Aircraft Noise Levels

Outright restrictions on the use of aircraft exceeding certain noise levels can reduce cumulative noise exposure at an airport. Aircraft producing noise above certain thresholds, as defined in F.A.R. Part 36, could be prohibited from operating at the airport at all or certain times of the day. A variation is to impose a non-addition rule, prohibiting the addition of new flights by aircraft exceeding the threshold level at all or certain times of the day. These restrictions would be subject to the special analysis procedures of F.A.R. Part 161. Any restrictions affecting Stage 3 aircraft would have to receive FAA approval.

Noise limits based on F.A.R. Part 36 certification levels are based on fixed national standards which are understood by all in the industry. They are average values, however, and do not consider variations in noise levels based on different methods of operating the aircraft. As an alternative, restrictions could be based on measured noise levels at the airport. This has the advantage of focusing on noise produced in a given situation and, in theory, gives aircraft operators increased flexibility to comply with the restrictions by designing special approach and departure procedures to minimize noise. It has the disadvantage of requiring extra administrative effort to design testing procedures, monitor tests, interpret

monitoring data, and design the restrictions.

Discussion: Whether threshold noise levels are based on F.A.R. Part 36 or measured results, care must be taken to ensure that the restriction does not fall with undue harshness on any one carrier. The feasibility of complying with the restriction given existing technologies and equipment also must be considered. If these things are ignored, the restriction could reduce the amount of air service in the community. It also would make the restriction subject to legal challenge and rejection by the FAA as unjust discrimination and potentially burdensome to interstate commerce.

Since January 1, 2000, RNO has had an air carrier fleet that is 100 percent Stage 3 compliant. Stage 2 business jets under 75,000 pounds are not subject to the Stage 2 phase-out law. This includes nearly all typical business jets. Restrictions of these aircraft would require an analysis based on F.A.R. Part 161.

Conclusion: Restrictions based on noise levels could be viewed as discriminatory and therefore be subject to litigation and rejection by the FAA. In addition, the requirements of a costly F.A.R. Part 161 Study would have to be met before any restriction on Stage 2 business jets under 75,000 pounds and Stage 3 air carrier aircraft could be implemented. Therefore, this measure does not merit further discussion.

Touch-and-Go Restrictions

Restrictions on touch-and-go or multiple approach operations can be effective in reducing noise when those operations are extremely noisy, unusually frequent, or occur at very noise-sensitive times of the day. At many airports, touch-and-go's are associated with primary pilot training, although this type of operation is also done by licensed pilots practicing approaches.

Discussion: Current noise abatement procedures contain the following restrictions regarding touch-and-go activity:

- No training operations are permitted on any runway between 10 p.m. and 7 a.m. Monday thru Friday and until 8 a.m on weekends and holidays.
- Touch-and-go operations are restricted to piston-powered aircraft. (Aircraft over 12,000 pounds require prior written approval.)
- Jet touch-and-go and low approaches are prohibited.

Pilots wishing to perform touch-and-go operations in contradiction to these restrictions will need to request permission from the on-duty operations officer. All turbojet and large turboprop aircraft traffic operating at RNO is considered to be itinerant.

Conclusion: Although training operations including practice instru-

ment approaches and touch-and-go operations are commonly performed by piston-powered aircraft, current restrictions curtail such activity by more intrusive aircraft. In addition, these restrictions prohibit training activity during times when the noise generated would be an excessive burden to surrounding land uses. Additional restrictions on touch-and-go operations for noise abatement purposes would yield little benefit and do not merit further discussion.

Engine Run-up Restrictions

Engine run-ups are a necessary and critical part of aircraft operation and maintenance. Run-ups are required for various aircraft maintenance operations. Engine run-ups are often more annoying than aircraft overflight noise because they are more unpredictable, have a more sudden onset rate, and usually last longer. In addition, because run-ups occur on the ground, they tend to be more sensitive than overflights to atmospheric effects. Temperature inversions, for example, can cause noise on the ground to travel further. For all these reasons, run-up noise can be more annoying than a cursory analysis of A-weighted noise levels might indicate.

Engine maintenance run-ups may be restricted by airport operators. These restrictions, when they apply to run-ups as a separate function from the takeoff and landing of the aircraft, do not appear to need special FAA review or approval under F.A.R. Part 161. (See *Airport Noise Report*, Vol.6, No. 18, September 26, 1994, p. 142.) They are, nevertheless, subject to other legal and constitutional limitations on unjust discrimination, undue interference with interstate commerce, or conflict with FAA grant assurances. As previously discussed, noise due to aircraft maintenance run-up operations could be mitigated through the installation of a run-up enclosure such as a hush-house. If constructed, it will be essential to establish policies for the use of that facility.

Discussion: RNO currently has several restrictions concerning maintenance run-ups:

- Engine run-up procedures are conducted at the north end of Taxiway "C" or at a location designated by Airport Operations.
- Air carriers wishing to perform maintenance run-up operations are required to notify Airport Operations at least one hour prior to performing the operation.
- Jet engine run-ups above idle power are prohibited between 2 a.m. and 6 a.m. (The Operations Office may authorize run-ups at alternative times.)
- Engine run-ups shall be limited to a duration of five minutes.
- No aircraft may perform more than four run-up operations per day.
- All run-up operations will be completed within a 30-minute period.
- In the event that a run-up event generates complaints, air carrier operators will be required to reduce run-up power or cease run-up operations.

Conclusion: Aircraft operational and maintenance run-ups are an integral part of operations at RNO. A number of restrictions are currently in place concerning maintenance run-up procedures and additional restrictions would greatly hinder airport operators, safety, and would likely facilitate litigation. The additional mitigation of run-up noise would best be addressed through the utilization of a run-up enclosure such as a "hush-house" and the establishment of policies governing run-up procedures.

SELECTION OF MEASURES FOR DETAILED EVALUATION

Preliminary screening of the complete list of noise abatement techniques indicated that some measures may be potentially effective in the RNO area. These are evaluated in detail in this section.

EVALUATION CRITERIA

Four operational alternatives have been selected for detailed analysis in addition to the possible effects of a run-up enclosure. The noise analysis for each alternative was based on the 2005 baseline analysis presented in Chapter Four, "Aviation Noise Impacts." The 2005 baseline was chosen to offer a common base of comparison for all alternatives. This timeframe allows time for FAA review and approval of the final Noise Compatibility Program and any environmental assessments which may be required prior to implementation of the procedures. The alternatives are evaluated using the following criteria:

Noise Effects. The purpose of this evaluation is to reduce aircraft noise on people. A reduction in noise impacts, if any, over noise-sensitive areas are assessed.

Operational Issues. The effects of the alternative on the operation of aircraft, the airport, and local airspace are considered. Potential airspace conflicts and air traffic control (ATC) constraints are discussed, and the means by which they could be resolved are evaluated. Potential impacts on operating safety are also addressed. FAA regulations and procedures will not permit aircraft operation and pilot workload to be handled other than in a safe manner, but within this limitation differences in safety margins occur. A significant reduction in safety margins will render an abatement procedure unacceptable.

Air Service Factors. These factors relate to a decline in the quality of air transportation service which would be expected from adoption of an abatement measure. Declines could possibly result from lowered capacity or rescheduling requirements.

Costs. Both the cost of operating aircraft to comply with the noise abatement measure and the cost of construction or operation of noise abatement facilities are considered. Estimated capital costs of implementing the noise abatement alternative, where relevant, are also presented.

Environmental Issues. Environ-mental factors related to noise are of primary concern in an F.A.R. Part 150 Update analysis. Procedures that involve a change in air traffic control procedures or increase noise over residential areas