The UNR Department of Physics is a highly productive organization that is, however, under tremendous stress. It faces doubled teaching loads over the past decade without corresponding resource allocations, and potential loss of operations funding at the Nevada Terawatt Facility (NTF). In spite of the dramatic increase in the numbers of declared physics majors and students taking introductory physics, in terms of tenure-track faculty numbers the Department is the same size it was a half-century ago. Physics is a core activity for any major research university. A vibrant, productive physics department is essential in order to attain R1 status for UNR. Conversely, when a physics department remains the same size while absorbing a factor-of-several increase in teaching responsibilities, it will not long be able to help UNR improve its reputation, ranking or classification.

The evaluation committee reviewed pertinent materials provided by the UNR Provost’s office and the Physics Department self-study. It conducted interviews with UNR Deans, the department chair Dr. Paul Neill, and many physics department faculty and students over a two-day period.

**Strategic recommendations for improvement:**

- UNR must add multiple new state-supported tenure-track faculty positions in order to preserve the essential research and teaching roles of the Physics Department.
  - The unfunded Space Physics cluster proposal seemed like an excellent step forward for the department, both expanding and unifying.
  - We strongly encourage the University to reconsider this or similar initiatives to address the shortage of tenure-track faculty positions.
  - Such a proposal builds on existing strengths and also enables diversification of the research portfolio.
  - TA loads have become excessive and incompatible with proper progress towards the PhD in many cases, not to mention poor pedagogy.

- The future of the Nevada Terawatt Facility needs careful attention by the University. There is every reason to believe that modest contributions in the form of returned F&A to the NTF would enable NTF personnel to preserve this unique research facility and stabilize this important UNR resource. NTF provides excellent opportunities for graduate student and faculty research.
• The ATMS program is currently the smallest such program in the country and needs to be expanded with new state-supported tenure-track faculty positions to become sustainable.
  o UNR and Desert Research Institute (DRI) should explore joint faculty appointments. Faculty who hold these appointments would have explicit responsibility for strengthening the communication and interaction between the two institutions.
  o UNR and DRI should work together to identify strategic joint initiatives which can expand their funding bases and increase collaboration between the two institutions.
  o The undergraduate curriculum should be expanded to ensure that it explicitly satisfies the Office of Personnel Management requirements for employment as a professional meteorologist (Meteorology Series 1340).

Department Commendations:

• The UNR Department of Physics has very productive faculty in terms of grants, publications, and students being graduated at both undergrad and grad level.
• They have very effectively handled an enormous influx of additional students without corresponding investment from UNR.
• They are very responsive to students needs in terms of academic advising, placement, and a supportive departmental atmosphere. The committee found a very high level of student satisfaction at both undergrad and grad levels.
• Involvement of undergraduate students in research is excellent.
• All courses are taught by PhDs.

Department Challenges

• Class sizes are generally quite large and have been continuously increasing over a number of years. At the introductory level, they are at full capacity. At advanced undergraduate levels, course sizes are unwieldy.
• Due to staffing constraints, the graduate course offerings have been cut back to an unreasonable level.
• Morale, particularly among research faculty, is quite low.
• The most productive tenure-track faculty are generally dissatisfied with the current situation and there is a very real risk of losing the strongest researchers to outside offers.
• Startup packages are demonstrably insufficient to attract top faculty. Arguments from University leadership that physics faculty are too expensive are short-term and ignore the substantial F&A return on this investment, not to mention the high scholarly productivity of the physics faculty.
• Institutional level High Performance Computing (HPC) has not yet been realized and is essential for many research programs.
• The committee is surprised that TAs are not used for recitation sections at the introductory level. The restriction of TAs to laboratory instruction is an unusual practice and we note that both TAs and students would profit from the use of TAs to teach recitations.
• Recruiting of high quality graduate students continues to be a challenge and the department needs to be purposeful.
• Students report insufficient training in scientific writing and communication at both the undergraduate and graduate levels.
• Students report inconsistent material coverage in graduate courses.
• Research faculty are being evaluated using the same criteria as tenure-track faculty, even though their functions are often quite different.
• Administrative support staff report being overworked.

Evaluation (include strengths, weaknesses, and recommendations for improvement) for each area:

Recruiting/Enrollment/Progression (recruitment materials, recruitment activities, department website, enrollment trends)

Undergraduate  The physics program is graduating a very good number of majors, considering the very modest faculty size. Recruitment is done primarily at the College level and informally through contact with introductory course lecturers. Enrollments in both service courses and majors courses have surged in the past decade, with minimal response by the university. A near-doubling of the physics faculty size would be required to meet the University-wide goal of 18:1. The Department now teaches the large service courses entirely with non-tenure track instructors (except for a small honors section taught by the chair). The department is to be commended for respecting and treating the instructors well.

The ATMS undergraduate program remains at a barely functioning level. Although the number of majors has started to increase over the last couple of years, the program remains the smallest in the country in terms of B.S. degrees awarded. Expansion of this program, probably best done in concert with DRI, is advisable to attain sustainability. Given the interdisciplinary nature of the subject, this expansion would not necessarily have to be all within the physics administrative structure. In discussing this with ATMS faculty, issues with math requirements were raised that will need to be considered. The program uses some creative solutions, such as mixed 400-600 level courses, to teach reasonably sized courses with limited staffing.

Physics majors courses have reached sizes (30+) that detract from the kind of faculty-student interactions that result in best learning. There is no grading support, resulting in unproductive use of faculty time for grading homework papers.

The practice of teaching introductory physics solely with large lectures and laboratories is quite unusual. The committee was impressed by the lecturers and laboratory
manager who manage this essential part of the departmental teaching responsibilities, and there is no reason to believe they are not doing a good job. However, we note that most universities have long since reduced the lecture component of these courses and teach small (~25 student) recitation sections using teaching assistants. Implementing such a structure would require many more TAs that would in turn require growing the physics faculty size, another among many arguments for growth in physics faculty size. For the TAs themselves, being able to have a genuine teaching experience beyond the laboratories would be desirable for those continuing on in academia. Careful study beyond what was possible for this review committee will be needed to determine what if any changes should be made to the current UNR introductory physics teaching practices. But we do note that the UNR practices are unusual for major universities.

We note that the enrollment pressures in the introductory courses are not limited to filled classrooms, but the laboratories are at full capacity in equipment, rooms, and TA availability. The reported average of 72 students per TA in 3 lab sections represents a very heavy load on TAs. Both faculty and graduate students report that TAs have difficulty maintaining good progress on their research while managing the TA teaching loads.

Graduate: Enrollments in the physics graduate program have gone down in recent years, perhaps a semiconscious result of there being a reduced number of research faculty and concerns about being able to properly supervise the previous numbers of graduate students should the NTF close. The program accepts a relatively modest fraction of the applicants it gets, and the percentage of students who fail out is small, so the department is clearly being selective in admitting only those students who they are confident have the ability to complete the program. The committee does not recommend reducing entrance standards in order to increase enrollment.

The graduate students the committee met with, both as a group and during informal lab tours, were upbeat about their experiences at UNR. The students reported the perception that the average student will publish 3-5 papers while at UNR, a very healthy level that shows that the students are becoming productive scientists as a result of the program. It also indicates high standards for performance being held up by the faculty. The time to PhD of about 6 years is reasonable and consistent with most other physics graduate programs.

Both the Department representatives and the committee agree that recruiting efforts have been minimal. They could very well improve graduate student quality with a coordinated effort. The committee was surprised that financial support for recruiting from the Dean of College of Science was not taken advantage of. Given the high degree of satisfaction reported by the graduate students, having a visiting weekend where prospective students mingle with current students could be an effective recruiting tool. The late application deadline of March 1 is unusual, and leaves little time for the recruiting weekend. The department’s usual practice of accepting students as applications arrive, rather than waiting until March 1, is logical in order to capture good students who for whatever reason are still available at that late date. It is not clear what
the best solution is, but the department is encouraged to carefully consider its graduate recruiting and admissions practices in order to get the best possible students.

Curriculum (curriculum organization, credits, relevance, currency, availability of courses, etc.)

**Undergraduate**: The ATMS degree does not officially meet minimum requirements for employment as a professional meteorologist under the Federal job code (Meteorology Series 1340). The committee learned that ATMS faculty have been able to avoid this apparent problem by justifying on a case-by-case basis that the ATMS students have indeed received the necessary instruction in the various courses they have taken. This is a creative solution to the problem of running the ATMS program on such a shoestring and an example of the attentiveness and personal attention paid by the faculty to the needs of individual students. However, every effort should be made to rectify this situation to ensure that students graduating with a B.S. degree can pursue all available job opportunities.

The intermediate and advanced physics curriculum is a good one and UNR physics students seem to be well educated and prepared upon graduation. The Department is doing an excellent job getting students involved in research.

The majors the committee met with complained of disconnect between the difficulty of the intro course (with minimal use of calculus) and the quite rigorous upper level courses. This is not surprising as the intro courses must meet the needs of a wide variety of less-prepared students. If, upon further investigation, this is determined to be something that needs addressing (it is not obvious to the committee that this is an actual problem), a possible solution would be the introduction of a physics major oriented section of first year physics, perhaps by replacing the honors section.

**Graduate**  The graduate curriculum has been squeezed, with many courses rarely being taught due to high undergraduate program demands getting priority. The HEDP courses in particular are perceived by students as lacking coherence. Students felt that the course content in key courses such as E&M varied wildly depending on who the instructor is. This has a practical impact on preparation for the comprehensive exam.

The purpose of the comprehensive exam is unclear and the committee notes that most graduate programs have eliminated this exam. However, the students interviewed by the committee did not view the exam as inappropriate, and there are widely varying views among the faculty about the relevance of the exam, considering that all students have to take graduate level courses on all the topics covered by the exam. This is something that should be reviewed by the department faculty.

Advising (staffing, leadership, career counseling, mentoring)
Undergraduate: The Department was highly rated by students for their accessibility for advising. The introductory course lecturers are keenly aware of the importance of identifying prospective physics majors and reaching out to them in the first year. The advising for more advanced students is done informally and students are expected to take the initiative, but students felt that the high level of accessibility of faculty made the advising of high quality. The high degree of research involvement of undergraduates also provides a natural means of advising from the supervising faculty members. The Society of Physics Students organization is a great asset. However, the Society functions partly as a student-self-generated necessary substitute for recitation sections that do not exist in the larger courses.

Graduate: The Department was praised by graduate students for a pervasive open-door policy and the students felt that they were properly advised. The ratio of graduate students to faculty is, on average, appropriate when research faculty advisors are included. Graduate student TA’s are limited to undergraduate laboratories; in the absence of recitation sections, the students graduate without any substantial teaching experience. This may handicap students who expect to take a university postdoc or proceed to a primarily teaching institution.

Student Learning and Success (assessment of program learning outcomes, retention/graduation/time-to-degree, job/graduate and professional school placement)

Undergraduate: Undergraduate student success can be tied to the Department requirement that all undergraduate physics majors complete a senior research project. The faculty take this seriously and in spite of the increase in the number of majors, the Department has the facilities (especially NTF) to accommodate the projects. This experience is good preparation for all students whether they intend to continue with graduate work or not. It also gives an indication of work expected in graduate programs and a number of Department graduate admissions come from the physics major cohort.

Graduate: Graduate students report some inconsistencies in core courses taught during the first two years, not only with the usual varied instructional styles, but also with textbooks. If a textbook is chosen at too low a level, the student may be unprepared for the comprehensive exam (referred to here as the COMP). Since the COMP is not necessarily constructed by the faculty who taught the course, it is then up to advising faculty to consider passing a student who performs marginally; most students are passed. Thus the COMP is not necessarily an effective filter. Since the COMP is a bottleneck that the student must pass through in order to continue with a doctorate, the students often treat the first two years mainly as preparation for the COMP. If instruction were consistent, the COMP would be redundant with the course work and a greater focus could be placed on research.
The committee recommends that the Department evaluate the possibility of eliminating the COMP (as has been done in most university physics departments in the last 20-or-so years). Were this done, the core graduate physics courses would need to be taught in a consistent and rigorous manner, requiring enhanced oversight from the Department. Students could work more to understand the course content rather than to trying to predict how questions might appear on a comprehensive exam some time down the road. Rigorously reviewed course grades would then be filter permitting successful students to continue. That said, matriculating PhD’s spend a reasonable amount of time pursuing their degrees (the 7.5-year time-to-degree for 2014-2015 is presumed to be an anomaly), the great majority have found good positions after graduation and they appear to be successful.

Program/Department (management, organization, leadership, planning, culture, administrative and professional staffing)

The UNR physics department leadership structure focuses on the department Chair, with support from the directors of undergraduate and graduate programs in physics and ATMS, and the director of the NTF. With the tremendous growth in student numbers and stagnant or decreasing faculty numbers (including research faculty), combined with NTF funding instabilities, the time since the last review has been a difficult and stressful period.

Although the department climate is reported by most faculty to be collegial, the department chair job has been exacerbated by a small number of serious personnel problems that jeopardize the working climate of the department and will need to be addressed by UNR in order to find a new chair within the next year.

Annual merit evaluations are performed by a departmental committee that came under some substantive criticism from research faculty in particular. This situation should be studied and appropriate changes made by the department and UNR administration. Current practice has resulted in strange situations such as supervisors being evaluated by their supervisees.

The current NTF leadership has done a remarkable job of reorganizing operations to provide a safe and invigorating environment for users of the Facility. That leadership has done, and continues to do, an excellent job of shepherding the Facility through the period of termination of the Cooperative Agreement with NNSA.

Administrative support staffing for the department, 2 FTE, self-report excessive loads and responsibilities for supporting the substantial research and teaching enterprise of the department.
Facilities (teaching, faculty/staff offices, laboratories, and space unique to the department)

High-throughput computing infrastructure is needed and currently unsatisfactory to a number of faculty. UNR is taking steps to improve this situation, and there is optimism that this problem will be soon be solved.

Student shop facilities have been shut down, so that shop support is limited to the professional machine shop. In principle, the free machine shop is a very nice research benefit, but it can be hard to prioritize the work that is submitted. Several faculty complained of long wait times as a result. The question of whether or not throughput and effectiveness might be improved by instituting nominal charges should be looked into.

Generally, it seemed that the current space is adequate for the experimental research program. This is probably a by-product of the understaffing of the department and space in the current physics building may become inadequate when new faculty are added. This is possibly addressable in the short to medium term by utilizing space at the NTF facility.

Faculty (morale, retention, mentoring, promotion, workload, hiring priorities)

A key factor affecting faculty morale is the failure of the university to respond to the burgeoning teaching loads with tenure track hires. They are well aware of their high research productivity relative to other parts of the university, and are justifiably perplexed that the university has not taken sufficient action.

An unusual feature of the UNR physics department is the large number of research faculty on soft money. These faculty are only too aware of their precarious situation in the event of losing research funding. Given the NTF situation, it is probably a good time for both the department and the university to clarify the roles of research faculty and tenure-track faculty. In particular the committee was made aware that, per University policy, both types of faculty are evaluated using the same basic standards (research, teaching, service) even though some of the research faculty - by design - have 0% components of some of these activities. This has also led to strange practices at times where supervisors are being evaluated by those whom they supervise. The department and university should take care that each member of the department is evaluated fairly using clearly understood standards that are appropriate for their job functions.

The committee understands that even when the university has allowed for tenure-track replacements, recruiting of new faculty has been hampered by below-market startup packages for experimentalists. We emphasize that these startup packages are not largesse or “signing bonuses”; they are essential to the initiation of a new research program. Funding agencies expect that universities are supplying sufficient funds to get
new faculty started; it is usually very difficult for new faculty to obtain funding before initial results are obtained.

It is true that the startup packages seem expensive on the short term, but it is essential for the administration to recognize that on the average these funds will be returned to the university in F&A charges. The physics department has a strong record of obtaining substantial outside funding with very significant F&A expenditures. There is no doubt that these packages can be a short-term strain on department and university budgets, but it is essential to take a long-term view of these things and realize that the long-term health of the university make these investments worthwhile.

The committee commends the department for maintaining high standards for faculty productivity in both teaching and research. It is important that these standards not be lowered as a short-sighted solution to staffing problems.

**Research/Funding (productivity, reputation, new sources)**

The research productivity of the physics department is very impressive. There are several important facts to note. The average publication rate of 5 or more per faculty per year is excellent. Many of those publications are in very high impact journals such as Physical Review Letters. The funding of the department remains very strong, even considering the decline in the NTF funding over the past decade. The F&A of the department is a very significant fraction of the state supported faculty salaries, and non-department administrators confirmed that the F&A generated by the department is among the largest in the University, despite the small faculty size. Several faculty have garnered UNR research awards in the past few years. The research program is supporting a very healthy number of graduate students. The committee holds the UNR physics research program in very high regard.

**HEDP:** As the NTF has been ramping down the HEDP faculty have adapted from a focus on locally done experiments to doing a variety of off-site experiments. They are supporting many students and remain quite productive. The university needs to take a close look at what portion of the NTF facility should be retained for local HEDP physics faculty use after the current NTF funding is used up, should center funding not be obtained in the meantime. There are real possibilities for other external funding sources to be found to supplement university support. This will be elaborated below.

The committee notes that many of the HEDP faculty are research faculty. They have been extremely productive and successful at bringing in outside funding. It did seem to the committee that the HEDP faculty do not work particularly well together and it will be important for them to improve on this in the future as they work to get new funding for local facilities.
AMO: The AMOC faculty are very strong, both in theory and experiment. The group is cohesive, well-funded, and publishing many innovative results in the top journals. It has managed to recruit exceptional young faculty who have done very well. UNR should be quite concerned that the faculty of all ages could be hired away and may face significant retention issues in the near future. One strength of the AMO group is having two theorists, the senior one with a substantial international reputation and a very promising junior faculty member as well. The department and university should consider the possibility of building on this strength as means of increasing the faculty size and quality with less severe startup commitments.

NTF: A very significant issue facing the HEDP/NTF group is the uncertain funding status of the NTF. The NTF is the anchor that holds the Department HED effort together. The NTF is operating on no-cost extensions of the now-terminated NTF NNSA Center-of-Excellence funding through the end of calendar year 2017, and faces a shut-down of operations if no funding for operations is obtained by then. As a consequence, the Department has terminated new long-term student projects there. Most of the faculty involved in the NTF have acquired other funding for their research, but generally federal agencies are reluctant to provide operating funds for facilities such as the NTF; in fact NNSA does not permit such funding. Obviously, it is recommended that the Department continue to hunt for funding beyond NNSA.

The Department is in the process of responding to DE-FOA-0001634, a proposal call for FY2018 that recompetes all of the NNSA Centers of Excellence (COE). The call does not require matching funding but it certainly does not preclude it. It is strongly suggested that the University consider matching funds in order to improve the probability of a successful proposal. University matching funding could be an amount similar to that discussed below. However, given the number of university consortia known to be submitting proposals and the increase in the number of COE categories, it is thought that the likelihood of a successful NTF COE proposal is not large.

In view of the strategic importance of NTF, the University should carefully consider subsidizing a fraction of operations there. The NTF leadership are proposing that UNR use a roughly 50% return of F&A to the NTF as a university contribution that would cover roughly half of the operation costs (which are mostly for qualified PhD-level personnel to run the quite complex equipment). The NTF leadership believe that such a contribution by the UNR to the facility will allow them to raise the additional 50% of the operating funds from various sources. The arrangement of a 50% F&A return may seem expensive, but it is much preferable to losing the center’s funding and F&A contributions all together, not to mention the fracturing of the HED concentration in the Department.