is restarted will be missed by the erase head and will receive the new buzz on top of the already recorded buzz. The segment must be precisely the length of the gap between the erase and record heads on the Uher 5000, which is 28.6 millimeters, and last for 1.22 seconds at the Uher's play speed.‡

Sound on tape can be visualized by measuring its amplitude or taking a sound spectrogram. Figure 1, taken from the panel's report, shows the amplitude wave form and sound spectrogram of a portion of the 20 June tape said by the panel to contain a buzz-on-buzz segment. The segment begins with a signal which the panel says is a "record head on" mark and ends 1.22 seconds later. Says the panel: "As can be the case, the hypothesized buzz-on-buzz appears quite subtle, but may be discernible in the low-frequency components of the spectrograms."

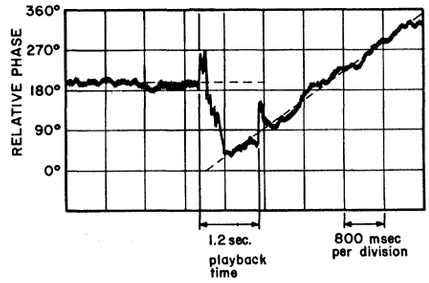

Fig. 3. Tracing shows a change in the phase of the 60-cycle-per-second buzz. The panel says the change of phase means that the tape recorder stopped, Bell that the motor changed speed by less than 1 percent.

Bell's position is that the hypothesized buzz-on-buzz is subtle to the point of not in fact existing. The two buzzes should create an interference pattern but none can be seen. Neither the spectrogram nor the wave form show any change at the end of the 1.22-second period, yet the buzz-on-buzz segment must be precisely this length if the panel's theory is correct. One of the other two postulated buzz-on-buzz segments shows a significant change at approximately the 1.22-second mark, but, says Bell, there are also seven other significant changes within one second's range of the mark.

● *K-1 and record head on pulses.*

‡ The buzz-on-buzz segments would last for less than 1.22 seconds if the tape were wound back for a distance less than the gap between the heads; in this case, however, the magnetic signature left by the record head when it is de-energized—the "record head off" mark—should also be present on the segment, and the panel found no instances of this kind.

NSF's Public Understanding of Science Program

The National Science Foundation is one of the last organizations in Washington that anyone would suspect of leading a crusade against nuclear energy. But just to make sure no one gets the wrong impression—least of all the powerful Joint Committee on Atomic Energy in Congress—the NSF has been refusing lately to sponsor seminars on the pro's and con's of nuclear power reactors because the subject is too controversial.

This, at least, was the explanation relayed to North Carolina State University in Raleigh and the University of Washington when the NSF recently turned down their requests to sponsor public forums on nuclear power. The two universities had independently sought a few thousand dollars apiece from the NSF's Public Understanding of Science Program to sponsor discussions by experts that would, it was hoped, help make sense out of the multiple controversies swirling around the safety and reliability of nuclear power plants.

How the explanation for their rejection came about is unclear, partly because everything transpired on the telephone. The NSF official in charge of the Public Understanding of Science Program, Richard E. Stephens, acknowledges turning down proposals for nuclear seminars, but denies it was because they were too sensitive. "Even if I believed that," Stephens says, "I wouldn't be stupid enough to come right out and say so."

But Stephens did say so in telephone conversations, insists a former staff member of the AAAS who acted as a go-between in the matter. "He was quite open about it," Kate Ecker says. "He said NSF couldn't be associated with anything like that. He mentioned that they were wary of being charged with sponsoring something that looked like a crusade against nuclear power."

The Public Understanding of Science Program spends about $1.8 million a year on projects ranging from traveling exhibits, to public symposiums, to the highly acclaimed "NOVA" series of science films produced by WGBH-TV in Boston, with AAAS assistance. The AAAS has received a little more than $100,000 in the current fiscal year for an assortment of educational projects, including a series of seminars on energy issues organized mostly through universities for the benefit of local civic and government leaders. Five have been held thus far, from San Diego, California, to Portland, Maine. And three of these have dealt at least peripherally with nuclear energy—among them the one at Portland, where an audience that included the governor of Maine heard the superintendent of the Maine Yankee Atomic Power Plant briefly debate a representative from the Sierra Club.

Ecker (who left the AAAS in May for Stanford University) helped organize the seminars. She says the NSF didn't object to including nuclear energy on the program, so long as it was only one of several topics. "That way," she says, "if it turned out to be an inflammatory meeting, we could just say 'that's the way it happened.' "

Last March, she invited North Carolina State's Energy Information Program to send the AAAS a proposal for a public seminar using NSF money. The university's energy group leaped at the chance and—with half a dozen nuclear reactors planned in the Raleigh area and two public hearings on the power plants coming up this summer—quickly settled on nuclear energy as the logical topic. After setting up a planning committee that included state energy officials, local civic leaders, and a representative of the local utility (Carolina Power and Light), the group notified Ecker. She described it all to Stephens, who turned it down cold. University staff, upset at the decision, related the issue in a letter to *Science*.

"He [Stephens] indicated that if we could guarantee a pallid academic discussion that would be all right," Ecker recalls. "But we couldn't do that."

The so-called K-1 pulses have a somewhat clouded history. They were not mentioned by the panel in its January presentations and, according to Rhyne, were in fact discovered by Hecker, who was hired by the President on 22 January. (Hecker claims in his report to have "made many contributions" to the panel's work. Be this as it may, the panel acknowledges help from no one.) Again according to Rhyne, Hecker disagrees with the panel on the identification of at least five of the six K-1 pulses on the tape.

The significance of the K-1 pulses is that, according to the panel and Hecker, they originate from a switch on the Uher 5000 called by the manufacturer the K-1 switch; further, the K-1 switch is only activated when the control buttons on the keyboard are pressed down. Bell, on the other hand, goes to the actual genesis of the pulse (an aspect the panel does not discuss) and argues that because of the way the K-1 switch is connected in the Uher's circuitry, the only mechanism for the pulse to be generated is by a slight arcing when the switch is closed or opened. But the same kinds of pulse can be produced by an arcing in any switch or relay in the recorder. The panel's criteria for recognizing a K-1 pulse are so loose that, Bell estimates, there are probably some 18,000 K–1 pulses on the 18½-minute section. Therefore it is only to be expected if some of the pulses appear to occur in association with record head pulses.

The panel claims that pulses which are K-1 pulses occur six times in such an association, three times with a record head on pulse and three times with a record head off. But Bell disputes the identification not only of the K-1 pulses but also of the record head on pulses. The so-called record head on pulses, he believes, are also proof positive that the panel's theory of keyboard manipulation cannot be right.

What the panel calls record head on pulses often occur twice or more in close conjunction. In each of these six instances the panel states—without explanation—that what appears to the eye to be a double mark is in fact a single mark. Only once does the panel explicitly refer to this discrepancy; describing the double mark occurring at time 1042.08 seconds (see Fig. 2), it says: "The pair of marks in the approximate middle of the picture is actually a single record head on mark." In

Treads Lightly around Nuclear Controversies

Stephens, in contrast, told *Science* that the reason he rejected the idea was that it didn't fit his program's guidelines. The rules say that proposals dealing broadly with science and technology "will generally be favored" over those treating a single discipline or field. On the same ground, he says, he's turned away proposals for solar energy seminars, even though NSF is the government's "lead agency" in this field. "We're just being cost-effective," he insists.

James Butler, the director of AAAS communications programs, noted that North Carolina had been considered only informally as a site for an energy seminar. He emphasized that, "I've never felt the NSF has tried to influence the content of our programs in any way."

Stephens says further that, while he strives for strict neutrality in public forums—"we're almost eunuchoid that way"—nuclear energy isn't taboo. As evidence, he notes that his program is spending $75,000 on a 6-month series of environmental and energy symposiums at Spokane's world fair, Expo '74. However, the main energy symposium has come and gone. Only one session, on 26 May, dealt exclusively with nuclear fission and fusion. The speakers advertised in a flyer were a top manager from General Electric, a leading vendor of nuclear power reactors, and a scientist from the Battelle Northwest Laboratories, one of the Atomic Energy Commission's contractors at Hanford, Washington. (The AAAS was not associated with this program.)

At another energy seminar the NSF helped sponsor —in Utah last October—Ernest J. Sternglass, who believes as firmly as ever in the dangers of low-level radiation, took part in a panel discussion of nuclear energy. Afterward the Denver *Post* reported that the panel was "dominated by the nuclear establishment" and that some panelists had privately threatened to boycott the affair if Sternglass were given full rein to discuss what the *Post* described as his "widely discredited" theories. Sternglass reportedly settled for jousting with fellow panelists and fielding questions from reporters.

Neither program, in any event, involved the kind of frontal approach to the nuclear debate that North Carolina State's plan—and a similar one from the University of Washington—envisaged. Ecker, though, says her "clear impression" is that NSF's resistance stemmed not from any hard and fast policy, but instead from a hypersensitive instinct for self-preservation.

She says she was given to understand that NSF's sensitivity stemmed from displeasure on Capitol Hill with a study the NSF released last August on nuclear power plant licensing and citizen involvement. The report, by two researchers at George Washington University, liberally criticized both the AEC and its adversaries.

An NSF official said the Joint Committee on Atomic Energy apparently first learned of the report from a newspaper story early last summer and had expressed "mild embarrassment" at not having been appraised of it sooner. But, the official said, the Joint Committee's reaction to the report itself had been "much milder than expected."

"There may have been a drawing in of horns [in NSF] since then, but I'm not aware of it," the official said.

It seems clear that the NSF as a whole has not adopted a policy of steering clear of nuclear controversies, although levels of caution in political minefields tend to vary from one part of the agency to another. (The NSF's energy policy office, for instance, is about to award a series of grants totaling about $500,000 for such things as a review of reactor safety R & D.) Whatever the reason though—caution, a lack of money, or a combination of the two—universities seeking to sponsor public discussions of nuclear issues will have to look for help somewhere other than the NSF's Public Understanding of Science Program.—ROBERT GILLETTE