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Valentine's Day closeup for Stardust-NExT

Spacecraft preparing for Feb. 14 close flyby of comet Tempel 1, which was encountered by Deep Impact in 2005

By Mark Whalen

JPL's Stardust-NExT spacecraft is preparing for a Valentine's Day encounter with comet Tempel 1 that will allow scientists for the first time to look for changes on a comet's surface that occurred following an orbit around the sun.

At its closest approach to the comet at approximately 8:37 p.m. Pacific time Feb. 14, Stardust-NExT will take high-resolution images of the nucleus and attempt to measure the composition, distribution and flux of dust emitted into the coma, the material surrounding the comet's nucleus. Data from the mission will provide important new information on how Jupiter-family comets evolved and formed.

The mission will expand the investigation of Tempel 1 begun by JPL's Deep Impact mission, which in July 2005 delivered an impactor to the comet's surface to study its interior structure and composition. The Stardust-NExT, or New Exploration of Tempel 1, spacecraft may capture an image of the crater created by the impactor, which would provide an added bonus to the other highly valuable data that mission scientists expect to obtain.

Project Manager Tim Larson noted that the recycled Stardust spacecraft has traveled almost 6 billion kilometers (3.7 billion miles) since its launch almost 12 years ago to achieve a successful mission to return samples of cometary material to Earth from comet Wild 2.

Larson noted that while "there's still fuel in the tank" to achieve the Tempel 1 flyby, prudent use of that fuel proves a major challenge. "With the way we design our spacecraft and our missions, we account for all kinds of uncertainties and unknowns; that's why we usually have some fuel left after

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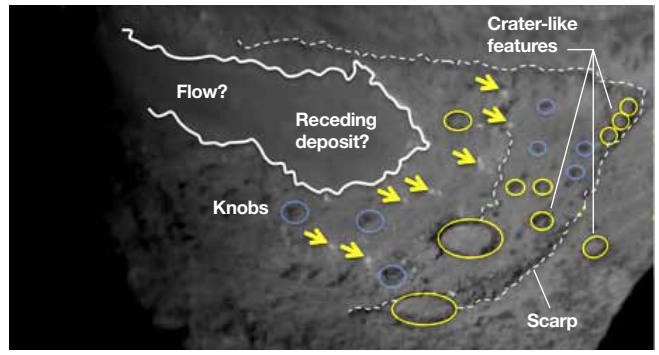


Scientists will compare Deep Impact's images of comet Tempel 1 with new pictures planned by Stardust-NExT on Feb. 14.

Passings

Solar system director Rick Grammier

Richard Grammier, 55, JPL's director for solar system exploration, died Jan. 23.

A native of Austin, Texas, Grammier achieved one of his childhood goals when he graduated from the U.S. Military Academy in 1977. Along with his parents, he cited as most inspirational his commanding officers at West Point "and the many, many outstanding classmates that I had. That's where I learned you could always do more than you ever thought possible, and even more if you teamed and took care of each other."

After a stay in the military of about five years, Grammier was working for an Arizona company in a non–space exploration role when he transferred to California to work in another branch of the company that was supporting the U.S. Air Force Space Command. During this time he returned to college to earn a master's degree and learn more about the space business, and in 1989 he "jumped at the opportunity to go to work for JPL and continue in the space exploration field."

Grammier contributed to numerous flight projects including Cassini (command and data subsystem manager), Stardust (project engineer and deputy project manager), Deep Impact (project manager), and Juno (project manager). He also managed JPL's Office of Mission Assurance.

Grammier termed JPL "a great work environment (that) continually provides opportunities to do things that have never been done before. You feel like one big family working together to solve really difficult but exciting problems that few people ever get the chance to address."

Grammier was awarded the NASA Exceptional Achievement Medal for Cassini, as well as two NASA Outstanding Leadership Medals for his accomplishments on Stardust and Deep Impact.

Grammier is survived by his wife, Laura, and children Daniel, David, Matthew, Jackson and Jessica. A funeral mass is scheduled for Feb. 7 at 10 a.m. at St. Bede the Venerable Catholic Church, 215 Foothill Blvd., La Canada. A memorial will also be held that day at 11:30 a.m. at JPL.

Rick Grammier, left, joined members of Bill Haley and His Comets, who performed a concert at JPL following Deep Impact's successful mission at comet Tempel 1 in 2005.

Retiree flies high for birthday

Dona DuQuin, a retired JPLer now living in New Mexico, considers herself an "ordinary" person: "5'1" with no extraordinary talents," she says. "But I feel that's the blessing of being 'ordinary'—you can try anything; you have nothing to prove. The basic principle of my life is to 'Show Up and Wing It!'"

That's exactly what took place for DuQuin, a former secretary in Division 340, as she returned to California for the holidays. Her skydiving adventure at Lake Elsinore, Calif., on Dec. 31 celebrated her 75th birthday with the youngest of her seven children, daughter Dona Morford of Anaheim Hills, who was pre-celebrating her 40th birthday on Feb. 23.

"I can't believe I actually did it!," Dona said. "It doesn't take courage; I think perhaps it's more a lapse of sanity!"

But the high dive should be no surprise to those who know and worked with DuQuin, always involved and active at work and at home and looking forward to the next challenge.

A single mother of seven children when she started at JPL, DuQuin earned a bachelor's degree in business management from the University of Redlands in 1982 thanks to the JPL employee-education program and went on to earn a master's in marriage, family and child therapy in 1989. She also found time to learn cross-

country skiing with a JPL group. She retired from the Lab in 1993 after working in the University Affairs Office.

"I was and am grateful for all the opportunities JPL/Caltech provided for me," DuQuin said.

More fun awaits for the former Ms. Senior New Mexico, who also recently completed her first triathlon, in Castaic, Calif., as well as a 100-mile-plus bike ride.

One of DuQuin's favorite sayings guides her: "Blessed are those who are so naive that they don't know what they cannot do."

STARDUST-NEXT *Continued from page 1*

primary missions and that's what enables these kinds of extended missions," he said. "Every pointing function we do on the spacecraft consumes fuel, so the challenge is to make the fuel last as long as we need it to."

At the time of the encounter, Stardust-NExT will be almost on the exact opposite side of the solar system from Earth, about 336 million kilometers (209 million miles) away. During the close flyby, the spacecraft will take 72 images and store them in an onboard computer.

"We've had to be very judicious about planning the pictures, trying to make sure the 72 we get are really the cream of the crop," noted imaging team chief Ken Klaasen of JPL. "We are looking forward to seeing some beautiful stereo imagery right at closest approach."

Whether or not the team sees the crater, he added, it will still be good science because they will be viewing how much the comet has changed in one perihelion passage since it was last seen.

"If the face of Tempel 1 looks just like it looked on Deep Impact, that will be very revealing about how fast comets evolve and how much change there is from each passage close to the sun to the next," he said. "If it's changed a lot, that's going to tell us even more about how fast comets change. If we can see into the crater hopefully we'll see something in terms of layering, and get some idea of the internal structure of the comet that we don't really know.

"So far, every comet we've flown close to has looked different than any other one," added Klaasen. "It should be exciting."

Since 2007, Stardust-NExT executed eight flight-path correction maneuvers, made four circuits around the sun and used one Earth gravity assist to encounter Tempel 1. Larson said the last targeting maneuver approaching the comet would be two days before the encounter. The spacecraft is expected to fly past the nearly 6-kilometer-wide (3.7 miles) comet at a distance of approximately 200 kilometers (124 miles).

About an hour before arrival at the comet, the spacecraft will turn to orient itself with its dust shields facing forward for protection as it flies through the coma of the comet. About 30 minutes before closest approach, an Autonav software aboard the spacecraft will activate to analyze the pictures being taken of the comet, figure out where the brightness centroid is, define that as the center of the nucleus, and then adjust the position of the camera mirror so it can keep the nucleus in the camera's field of view all the way through the flyby of the comet.

Initial raw images from the flyby will be sent to Earth for processing that will begin at approximately midnight Pacific time on Feb. 14. Images are expected to be available at about 1:30 a.m. Pacific time on Feb. 15.

Lockheed Martin Space Systems in Denver built the spacecraft and manages day-to-day mission operations.

"We've addressed all the major uncertainties and challenges, so frankly I'm very confident that we're going to get a good flyby and good images of the comet," said Larson.

"It's going to be a great follow-up to the previous comet missions I've been involved with: Deep Impact and the Tempel 1 impact and flyby in 2005, the flyby of Hartley 2 by the Deep Impact spacecraft last November, and now the opportunity to go back to Tempel 1," added Larson. "For me it's a huge excitement, and every time we've pulled one of these missions off, new discoveries come out of them. So I expect this encounter to reveal some new discoveries for us, no matter which side of the comet we see."

Discussion honors Dr. King

Representatifves of JPL's affinity groups participated in a moderated panel discussion at the Lab's annual observance of the birthday of civil rights leader Martin Luther King Jr. The questions debated included challenges faced by men vs. those of women; King's feelings about affirmative action's effectiveness; benefits for gay partners of military personnel; the Arizona state immigration law; and civil rights taught as history lessons. From left are Randy Herrera, James Black, Susan Merrill, Yutao He and Bernardo Lopez.

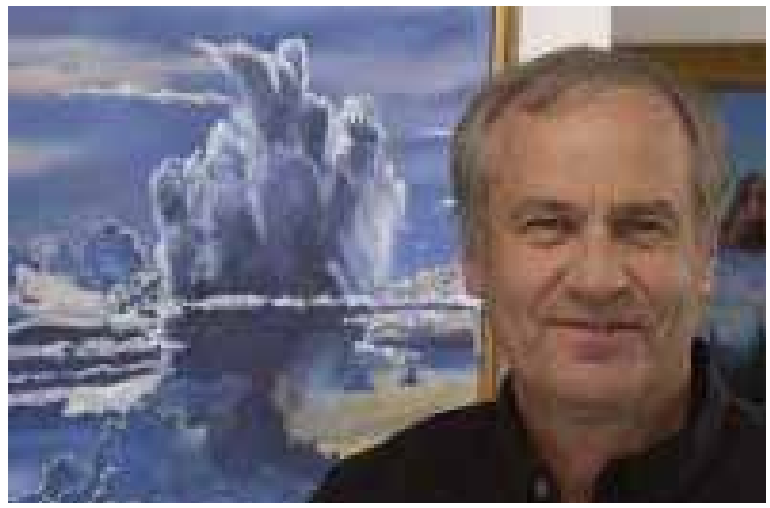
Carol Lachata / JPL Photo Lab

A model for tracking the home planet

JPL's Center for Climate Science to focus on Earth-system measurements

By Mark Whalen

Graeme Stephens, longtime atmospheric science professor at Colorado State University, noted climate researcher and the principal investigator for JPL's CloudSat Earth-observing mission, joined the Lab full time in the fall. Right now, he is working to establish JPL's new Center for Climate Science, an effort that will leverage the Lab's varied Earth-system research. Universe caught up with him for a discussion of the new center.



Graeme Stephens with one of his paintings.

WHAT'S BEHIND THE CREATION OF THE CENTER FOR CLIMATE SCIENCE?

There are pockets of excellence in climate science research performed at the Lab that are kind of fragmented, so this center is an attempt to bring some structure to it and to explore the interconnectivity between disciplinary sciences being done here.

Of course, there's a lot of local recognition about the excellent climate research on Lab. But the climate community doesn't generally think of JPL as a place where climate science is done. But typically when outside climate scientists visit JPL, they're shocked to see the breadth and depth of some of the activity that's going on here that's really pertinent to climate.

So it was felt there was a need to organize the research here and make it visible not only across the Lab, but also outside the Lab. So when the rest of the world thinks of climate, this could really give JPL a new identity in Earth sciences. Rather than identifying individual investigators, they will see JPL has a coordinated program in climate.

WHAT CAPABILITY WILL THE CENTER GIVE JPL THAT IT DOESN'T HAVE NOW?

First of all, there's a working assumption, from the outset, that data from many of the Earth science missions are important and relevant to Earth's climate. But it turns out that many measurements we make, in fact, aren't terribly helpful to the point of view of assessing our ability to project what's going to happen to future climate. Most of the measurements we make are about documenting or quantifying the Earth's climate today and how it has recently changed. This is important and needs to continue. However, it doesn't necessarily translate to what's going to happen in the future and doesn't necessarily give us the insight as to why and how future changes will occur.

The center will exploit the talents here and help shape the direction of research in the future. It will help define the issues and gaps in climate science, especially in relation to observations that we feel are critical to advance true understanding of the critical components of the Earth system and how these components interact, and the relevance of this to the climate predication problem.

That involves being organized and structured around the use of Earth- and climate-system models and in utilizing important and influential observations for testing our understanding of the Earth system and our ability to model it. The center will also provide connectivity to the leading Earth system models around the world.

JPL HAS A SOLID TRACK RECORD IN EARTH STUDIES. HOW MIGHT THAT IMPROVE?

What JPL brings to the table is an incredible depth of understanding of the observational capabilities of Earth. We also have a very wide range of applications and capabilities for modeling key aspects of the Earth system, so we can bring these capabilities together to where the whole will be greater than the sum of the parts.

By testing the advanced observations that JPL helps deliver, we can better determine what we don't understand and what we think we do understand. Working at the intersection of observations and model predictions is a way to do this and is something we will definitely bring to the table.

What matters for the problem of making climate projections isn't so much about how the atmosphere evolves, the chemistry and composition of Earth change or even how sea ice changes or oceans move heat around; it's really how these different but key aspects of the system interact with one another, each influencing the response of the other. To some degree that is what the center aspires to be about. A lot of the activity that goes on here lies at these intersections, but it's not necessarily well organized and some of the researchers here don't have simple access to these Earth-system models that could benefit their research and help them understand how their research links to the work of others.

AS A CONSEQUENCE OF THE CLIMATE CENTER, HOW DO YOU SEE JPL EARTH-SCIENCE DATA BECOMING MORE MEANINGFUL?

In particular, we can start to broaden the horizon for some of the research being done here. I see the need for a crosscutting vision. We might anticipate that folks working, say, in land hydrology might start coupling with the folks working in carbon, which could lead to more indirect research being developed at that intersection between carbon and water, for example. That's where the opportunities will lie and where the future direction of Earth science is likely to evolve.

With this approach, I think we can shape the direction of future observing systems and identify how we might develop a more integrated approach to Earth observations. We can start thinking about not measuring one parameter so much but rather consider measurements that relate to the Earth system in a more integrated way, which may mean making joint sets of measurements including tactical design and strategy for creating missions that supply such joint measurements.

So, indeed, it could impact the way we conduct and generate research.

HOW WILL THE CENTER BE ORGANIZED? WHAT ARE THE BEST WAYS IN WHICH THE DIFFERENT BRANCHES OF CLIMATE SCIENCE COULD COLLABORATE?

The main scope of the center will focus on five or six theme areas, with the overriding question being energy, water and carbon. From a climate-impact point of view, this is clearly where interest and focus exist now and in the future.

For example, in the key area of water, the movement of ice around the planet and the changes it undergoes clearly affects not only the water distribution; it also affects energy, because it changes the albedo of the planet. That, in turn, indirectly affects carbon, because it'll change precipitation distributions that further affect carbon pools through impacts on vegetation.

Where it makes sense—and where the impacts we feel exist—is where we're going to direct focus. This is why having a strategy and a marriage between the Earth system modeling groups is very important. Such links will allow us to be more quantitative about why we think research in certain areas will have impact and thus can help set priorities for us.

Anyone working in the climate sciences could be considered part of the center and part of the center's operations, especially when motivated to see things in a more integrated way and connect to the themes we are laying out.

The center starts toward its goals by funding between two and four new investigators and building partnerships through an academic partners program, which will comprise a handful of universities. We are also hoping to form partnerships with key modeling centers so we can begin to connect the great science being done here with those activities.

We're also going to have workshops in key areas, which will also help set priorities and integrate activities. Input from the scientists on Lab will help fashion ideas and direction. We want engagement from the science community here to help shape what the center will be.

IS THE CENTER UNDERWAY YET? WHERE WILL IT BE LOCATED?

It is underway. The kickoff event was Dec. 8 with a visit and lecture from Julia Slingo, the chief scientist of the UK Meteorological Office; this will help forge a strong relationship between the UK Met Office and JPL, with a developing visitor science program between both.

Our offices and staff are being organized and will be centralized in Building 233. The infrastructure is developing, like websites, etc.

HOW WILL YOU MEASURE SUCCESS?

Success would mean recognizing great science, in terms of science with impact. We could quantify success in terms of science publications and impacts, but also in definitions of new key measurements and articulating the case for them that in turn lead to new missions that might spin off from the research and the activities of the center, either indirectly or directly.

ON ANOTHER SUBJECT, I UNDERSTAND THAT A NUMBER OF YOUR CLOUD PAINTINGS ARE ON DISPLAY HERE ON LAB. DO YOU STILL PAINT, AND HOW DOES IT INSPIRE YOU IN YOUR WORK?

Yes, the story about that artwork is described in an article I wrote for New Scientist about how art and science intersected 200 years ago that touched on how clouds got their names, how meteorology began as a science and how all of this inspired the great skyscape paintings of the time, such as those of Constable. That article will be available on the center's website if readers are interested.

News Briefs

Jonas Zmuidzinas

Zmuidzinas named chief technologist

JPL Senior Research Scientist Jonas Zmuidzinas has been named JPL's new chief technologist, effective Feb. 14.

Zmuidzinas has served as the director of JPL's Microdevices Laboratory since 2007. His research focuses on astrophysics at submillimeter and far-infrared wavelengths, including the development of superconducting detectors and multiplexing techniques as well as instruments for ground-based, airborne and space telescopes.

He has collaborated closely with JPL scientists since he joined Caltech as an assistant professor of physics in 1990. The first collaboration involved the development of superconducting tunnel-junction receivers for high-resolution submillimeter-wave spectroscopy, a project that ultimately led to flight hardware for the HIFI instrument on the European Space Agency's Herschel Space Observatory.

Zmuidzinas currently serves as Caltech's project scientist for the Cerro Chajnantor Atacama Telescope, a proposed 25-meter telescope in Chile that will survey the distant universe using submillimeter cameras and spectrometers enabled by the superconducting detector arrays under development at the Microdevices Lab. Zmuidzinas has focused on upgrading the laboratory's equipment and infrastructure, increasing the visibility of the laboratory and its work, and establishing an external advisory Visiting Committee.

Abhinandan Jain

Jain book examines multibody dynamics

Abhinandan Jain, a senior research scientist in the Mobility and Robotic Systems Section, has authored a new book for advanced engineering students and researchers in the aerospace, robotics and mechanical engineering areas.

"Robot and Multibody Dynamics: Analysis and Algorithms" is a detailed exposition of the novel "spatial operator algebra" approach for the dynamics of articulated multibody systems pioneered at JPL by the late Guillermo Rodriguez and Jain. The spatial operator mathematical theory and algorithms are in use for the high-performance dynamics modeling and analysis of space platforms, robotic vehicles and biomolecular systems.

The book contains introductory material that establishes the fundamental approach, generalizations to a broad class of systems and expositions for several advanced research topics.

For more information, visit *http://www.springer.com/materials/mechanics/book/978-1-4419-7266-8.*

JPL-led Earth science proposals funded

Six proposals led by JPL principal investigators were recently selected for NASA's Earth Science Instrument Incubator Program. In all, NASA selected 16 proposals for funding over a three-year period of about $67 million.

The program is designed to reduce the risk of new, innovative instrument systems so that they can be successfully used in future science solicitations in a fast track (three-year) acquisition environment.

Here are the JPL-led proposals and their principal investigators:

A Deployable 4-Meter 180 to 680 GHz Antenna for the Scanning Microwave Limb Sounder, Richard Cofield; Aircraft Deployable Ultraviolet Short Wave Infrared Multiangle Spectropolarimetric Imager, David Diner; Prototype Hyperspectral Infrared Imager Thermal Infrared Radiometer for Earth Science, Simon Hook; Risk Reduction for the Precipitation and All-weather Temperature and Humidity Mission, Bjorn Lambrigtsen; Panchromatic Fourier Transform Spectrometer Engineering Model Instrument for the Geostationary Coastal and Air Pollution Events Mission, Stan Sander; and Atomic Gravity Gradiometer for Earth Gravity Mapping and Monitoring Measurements, Nan Yu.

For more information, visit *http://esto.nasa.gov/files/solicitations/IIP_10/ROSES2010_IIP_A35_selections.html.*

Engineering institute honors Rosen

Paul Rosen, manager of the Radar Science and Engineering Section, has been named a fellow of the Institute of Electrical and Electronics Engineers.

Rosen is recognized for his contributions to Earth and planetary radar remote sensing.

Fellow is the highest grade of membership in the institute, which has 385,000 members in 160 countries. Nominees receive endorsements from eight current institute fellows as well as other reviewers who assess the benefits of contributions to other disciplines or to additional contributions such as community service.

Goebel earns fellow designation

Dan Goebel, a senior research scientist in the Propulsion and Materials Section, has been named a fellow of the American Institute for Aeronautics and Astronautics.

Goebel, with JPL since 2003, works on research and development in electric propulsion. He is responsible for the development of high-efficiency ion and Hall thrusters, advanced long-life components such as cathodes and grids, and thruster life model validation for deep space missions. His expertise includes ion and electron beams, wireless communications and high-voltage power modulator technology.

Passings

Floyd Livingston, 82, a retired engineer and manager, died Oct. 28.

Livingston joined JPL in 1961. He headed the group in the Thermodynamics and Fluid Dynamics Section that performed shock-wave research simulating the conditions of planetary entry, and also was a manager in the Solar Thermal Power Systems Project of the late 1970s and early 1980s. After retirement in 1989, Livingston volunteered at Children's Hospital to develop an instrument to help children with hypoventilation syndrome, a sleeping disorder.

Floyd Livingston

Livingston is survived by his wife, Rose, five children and five grandchildren. Funeral mass was held in Surprise, Ariz.; he is interred in Chatsworth, Calif.

His family requests consideration of donations in his memory to Coalition for Pulmonary Fibrosis, 10866 W. Washington Blvd., #343, Culver City, CA 90232.

Rondle Nelson, 68, a retired contract technical manager, died Oct. 28.

Nelson joined the Lab in 1989 and retired in 2005. He contributed to projects including Galaxy Evolution Explorer, Europa Orbiter and All Source Analysis System.

He is survived by his wife, Sandra, and three children.

Stephen James III, 80, a retired senior electronics engineer, died Nov. 24.

James worked at JPL from 1991 to 2002. He contributed to Mars Pathfinder, Mars Global Surveyor 98, Cassini and the Mars Exploration Rovers.

He is survived by his wife, Karen, children Adair and Stephen IV, and grandchildren Kyle, Brendan and Breanna.

Services were held Dec. 11 in Port Gamble, Wash.

Terry Koerner, 80, a retired member of the technical staff in Section 342, died Nov. 30.

Koerner, who joined JPL in 1951 and retired in 1990, contributed to Corporal, Sergeant, Ranger, Mariner, Galileo and Voyager, for which he served as power system cognizant engineer.

He is survived by his brother Murray. Cremation services were held at sea.

Donald R. Johnson, 72, a retired electrical engineer, died Dec. 1.

Johnson spent 38 years at JPL, retiring in 2000. He designed digital electronics and worked on projects such as Voyager, Galileo, Magellan and Cassini.

Johnson is survived by his wife, Hanne.

A memorial golf tournament and lunch will be held in April. Former colleagues and friends may contact the family at hanne_don@earthlink.net. Remembrances in his name may be made to Friends of Foster Children, P.O. Box 1105, Arcadia, CA 91077, in care of the Special Activities Fund.

Robert Forney, 89, retired program manager for JPL's photovoltaic (solar energy) and Army programs, died Dec. 27.

Robert Forney

Forney joined JPL in 1951 and subsequently worked on the Corporal, Ranger, Surveyor and Mariner programs. He retired after 37 years of service.

He is survived by his wife, Ann; sons and daughters-in-law Thomas and Vicki, James and Mary, and David and Laura; and nine grandchildren. A memorial was held Jan. 2 in Sierra Madre.

Letters

My family and I would like to thank my JPL family for all of the support and love we've received during the recent passing of my stepfather. Thanks, too, for the lovely flowers. Your kindness and prayers have touched our hearts.

Keith Martin, Section 345

I would like to thank all my friends and colleagues at JPL for their thoughts and prayers after the passing of my mother. She was a wonderful mother whose unconditional love and caring defined who she was as a person and how she lived her life. Thank you for your thoughtfulness and friendship at this difficult time.

Brian Paczkowski

Retirees

The following JPL employees retired in January:

Arthur Freiley, 41 years, Section 333F; **William Irace,** 40 years, Section 7060; **Toshio Fujita**, 36 years, Section 354; **Jennifer Momjian,** 30 years, Section 2731; **James** Dillon, 28 years, Section 2456; **Philip Dumont,** 26 years, Section 383E; **Leslie Paal**, 25 years, Section 333F; **Rochelle Denmon**, 21 years, Section 508; **Nancy Aguilera,** 14 years, Section 1163; **Charles Minning,** 13 years, Section 3401.

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