Professional Certificate in Wind Energy Law and Regulation

Environmental Impact Assessment Requirements

Acid Deposition – Related terms: pH, soil buffering, atmospheric sulfur. Explanation: A chemical process where sulfur dioxide and nitrogen oxides convert to acids and fall to the ground, potentially harming vegetation near wind farms. Example: A turbine cluster in a coal-rich valley may increase local acid rain. Practical application: Conduct baseline soil pH testing before construction. Challenges: Isolating turbine-related contributions from regional industrial sources.

Adaptive Management – Related terms: monitoring, mitigation, feedback loop. Explanation: A structured approach that adjusts mitigation measures as new environmental data emerge during a wind project's life-cycle. Example: Modifying blade-strike mitigation after bird mortality exceeds thresholds. Practical application: Include a post-construction monitoring schedule in the EIA. Challenges: Securing funding for long-term data collection and stakeholder consensus on corrective actions.

Baseline Survey – Related terms: reference condition, pre-construction data. Explanation: The systematic collection of ecological, geological, and socio-economic data before any site disturbance. Example: Mapping bat roosts prior to turbine installation. Practical application: Provides a benchmark for impact comparison. Challenges: Seasonal variability may require multiple surveys, increasing time and cost.

Bird Strike Assessment – Related terms: avian mortality, collision risk, radar monitoring. Explanation: Evaluation of the likelihood that turbine blades will cause bird fatalities, based on species' flight patterns and turbine layout. Example: Using doppler radar to map migratory pathways over a proposed site. Practical application: Informs turbine placement to minimize high-risk zones. Challenges: Limited data on nocturnal migration and species-specific vulnerability.

Carbon Footprint Analysis – Related terms: life-cycle assessment, greenhouse gases, emissions inventory. Explanation: Quantifies total greenhouse gas emissions associated with manufacturing, transporting, installing, operating, and decommissioning wind turbines. Example: Calculating CO_2 equivalents for steel tower fabrication. Practical application: Demonstrates net climate benefit of the project. Challenges: Data gaps for upstream supply chains and end-of-life recycling rates.

Climate Resilience – Related terms: extreme weather, design standards, adaptation. Explanation: The capacity of a wind farm to maintain performance and safety under changing climate conditions such as stronger storms or higher temperatures. Example: Selecting turbine models with higher gust-speed ratings for coastal sites. Practical application: Incorporate climate-scenario modeling into the EIA. Challenges: Uncertainty in future climate projections and regulatory thresholds.

Construction Noise Impact – Related terms: decibel levels, sound propagation, community disturbance. Explanation: Assessment of acoustic emissions from site preparation, foundation drilling, and turbine erection, and their effects on nearby residents and wildlife. Example: Measuring peak noise during pile-driving near a protected night-roosting owl habitat. Practical application: Implement time-of-day

restrictions and noise-attenuation measures. Challenges: Cumulative noise from multiple contractors and variable topography.

Cumulative Impact Assessment – Related terms: additive effects, regional planning, impact matrix. Explanation: Evaluation of the combined environmental effects of the proposed wind project together with existing or reasonably foreseeable developments. Example: Assessing cumulative habitat loss when multiple farms are planned within a migratory corridor. Practical application: Use GIS to overlay all planned projects. Challenges: Data sharing between developers and limited jurisdictional authority to enforce mitigation.

Decommissioning Plan – Related terms: end-of-life, site restoration, recycling. Explanation: A documented strategy outlining turbine dismantling, material disposal, and habitat rehabilitation after the operational life ends. Example: Specifying that tower foundations will be removed to pre-construction ground levels. Practical application: Submit the plan as part of the EIA to obtain a construction permit. Challenges: Predicting future market values for reclaimed components and securing financial guarantees.

Ecological Connectivity – Related terms: wildlife corridors, habitat fragmentation, landscape ecology. Explanation: The degree to which natural habitats remain linked, allowing species movement across the landscape despite turbine placement. Example: Identifying a ridge that serves as a lynx dispersal route. Practical application: Design turbine setbacks to preserve corridor width. Challenges: Limited scientific consensus on minimum corridor dimensions for different taxa.

Ecological Survey – Related terms: flora inventory, faunal monitoring, habitat mapping. Explanation: Comprehensive fieldwork to document plant and animal species, community structures, and ecological processes on the project site. Example: Conducting nocturnal bat acoustic surveys during summer. Practical application: Informs mitigation measures such as turbine curtailment during peak activity periods. Challenges: Detectability bias and the need for specialist expertise.

Emission Standards – Related terms: air quality regulations, permit limits, pollutant thresholds. Explanation: Legal limits on airborne contaminants released during construction and operation, often expressed in micrograms per cubic meter. Example: Compliance with a national NOx limit of 40 µg/m³ for construction activities. Practical application: Choose low-emission equipment and implement dust-control plans. Challenges: Enforcement in remote areas and cumulative contributions from multiple projects.

Environmental Baseline – Related terms: reference conditions, pre-impact data, control site. Explanation: The set of environmental conditions (e.g., water quality, species abundance) measured before any project activity, serving as a comparison point for post-construction monitoring. Example: Baseline river turbidity values collected upstream of a proposed turbine access road. Practical application: Detects deviations attributable to the project. Challenges: Natural variability may mask subtle impacts.

Environmental Management Plan (EMP) – Related terms: mitigation hierarchy, monitoring schedule, corrective actions. Explanation: A structured document that outlines how identified impacts will be avoided, minimized, or compensated, and how compliance will be verified. Example: Including a bird-strike mitigation schedule in the EMP. Practical application: Required for permit issuance in many jurisdictions. Challenges: Keeping the EMP dynamic as new data emerge and ensuring contractor adherence.

Environmental Monitoring – Related terms: indicator species, data loggers, compliance audit. Explanation: Systematic observation and measurement of environmental parameters during and after construction to verify that impacts remain within predicted limits. Example: Installing acoustic sensors to monitor bat activity during turbine operation. Practical application: Provides evidence for regulatory reporting. Challenges: Selecting appropriate indicators and maintaining equipment in harsh field conditions.

Environmental Impact Statement (EIS) – Related terms: statutory document, public review, impact analysis. Explanation: A comprehensive report that integrates all impact assessments, mitigation measures, and stakeholder inputs required by law before project approval. Example: The EIS for a 150 MW offshore wind farm includes marine mammal disturbance analysis. Practical application: Serves as the primary basis for decision-makers. Challenges: Lengthy preparation time and potential for legal challenges if perceived as inadequate.

Environmental Impact Thresholds – Related terms: significance criteria, trigger levels, regulatory limits. Explanation: Pre-defined quantitative or qualitative limits beyond which an impact is considered unacceptable and requires mitigation or project redesign. Example: A threshold of 5 % loss of critical habitat area. Practical application: Guides impact assessment grading. Challenges: Thresholds may be contested by stakeholders and vary between jurisdictions.

Environmental Justice – Related terms: equitable distribution, community rights, procedural fairness. Explanation: The principle that environmental burdens and benefits should be shared fairly, ensuring that disadvantaged groups are not disproportionately affected. Example: Assessing whether a wind farm's visual impact falls on low-income neighborhoods. Practical application: Incorporate community engagement and benefit-sharing mechanisms. Challenges: Identifying vulnerable populations and reconciling conflicting interests.

Fish Passage Assessment – Related terms: aquatic habitat, turbine blade sub-mersion, hydraulic modeling. Explanation: Evaluation of how turbine foundations and associated infrastructure affect fish movement in rivers or estuaries. Example: Modeling flow alterations caused by monopile foundations in a salmon spawning stream. Practical application: Design foundation footprints to maintain adequate water depth and flow. Challenges: Limited data on species-specific flow tolerances.

Flora Impact Survey – Related terms: rare species, invasive plants, vegetation mapping. Explanation: Field investigation to identify plant species and communities that may be affected by turbine construction or operation. Example: Locating a protected orchid population near a proposed access road. Practical application: Adjust road alignment to avoid high-conservation value sites. Challenges: Seasonal emergence of key species and taxonomic identification difficulties.

Geotechnical Investigation – Related terms: soil bearing capacity, foundation design, seismic risk. Explanation: Subsurface exploration to determine soil and rock properties that influence turbine foundation engineering and potential environmental disturbance. Example: Borehole drilling to assess peat depth for turbine anchoring. Practical application: Reduces risk of excessive ground disturbance. Challenges: Disturbance from drilling itself may trigger erosion or habitat loss.

Habitat Suitability Index (HSI) – Related terms: species distribution model, suitability scoring, GIS analysis. Explanation: A quantitative tool that rates the suitability of a site for a particular species based on habitat attributes. Example: Using HSI to assess suitability for golden eagle nesting near turbine locations. Practical application: Prioritizes avoidance zones. Challenges: Data scarcity for rare species and model uncertainty.

Impact Mitigation Hierarchy – Related terms: avoidance, minimisation, restoration, offset. Explanation: A prioritized approach that first seeks to avoid impacts, then minimise, then restore, and finally offset residual effects. Example: Relocating a turbine to avoid a bat roost before considering curtailment. Practical application: Demonstrates compliance with best-practice standards. Challenges: Trade-offs between hierarchy steps and project economics.

Impact Prediction Model – Related terms: simulation, scenario analysis, statistical forecasting. Explanation: Computational tools that estimate the magnitude and spatial distribution of environmental impacts based on project parameters. Example: Using a noise propagation model to predict decibel levels at nearby residences. Practical application: Supports decision-making and permits. Challenges: Model calibration requires high-quality baseline data.

Indigenous Consultation – Related terms: free, prior, and informed consent (FPIC), cultural heritage, stakeholder engagement. Explanation: The process of engaging with Indigenous peoples to obtain their perspectives, consent, and participation regarding wind project impacts on traditional lands and resources. Example: Conducting a cultural heritage survey with tribal elders. Practical application: May lead to project modifications or benefit-sharing agreements. Challenges: Reconciling differing timelines and expectations.

Infrastructure Footprint – Related terms: land use, access roads, transmission lines. Explanation: The total area of land directly altered by project infrastructure, including roads, substations, and turbine foundations. Example: Mapping the cumulative footprint of a 30-turbine farm. Practical application: Helps assess land-use change and informs mitigation. Challenges: Cumulative visual and ecological impacts may be underestimated.

Invasive Species Management – Related terms: biosecurity, early detection, eradication. Explanation: Strategies to prevent introduction or spread of non-native species during construction and operation. Example: Implementing vehicle cleaning protocols to avoid seed transport. Practical application: Reduces risk of habitat degradation. Challenges: Ongoing monitoring and rapid response capacity.

Landscape Visual Impact Assessment – Related terms: view-shed analysis, photomontage, aesthetic value. Explanation: Evaluation of how turbines alter the visual character of a landscape, considering distance, height, and background contrast. Example: Producing photomontages of proposed turbines from a nearby heritage site. Practical application: Determines need for visual mitigation such as colour blending. Challenges: Subjective nature of visual perception and differing stakeholder preferences.

Marine Mammal Monitoring – Related terms: acoustic detection, strike risk, seasonal migration. Explanation: Surveillance of marine mammals to assess potential disturbance or collision with offshore turbine structures. Example: Deploying hydrophones to track dolphin presence during pile-driving. Practical application: Triggers adaptive curtailment when densities exceed thresholds. Challenges: Limited detection ranges and

high cost of continuous monitoring.

Mitigation Banking – Related terms: offset credits, habitat restoration, regulatory compliance. Explanation: A system where developers purchase credits from pre-restored habitats to compensate for unavoidable impacts elsewhere. Example: Buying credits from a wetland bank to offset turbine foundation disturbance. Practical application: Provides flexibility in meeting mitigation requirements. Challenges: Ensuring equivalency of ecological functions and long-term credit validity.

No-Net-Loss Principle – Related terms: biodiversity offset, compensatory restoration, ecological accounting. Explanation: The goal that any loss of ecological value from a project is balanced by an equivalent gain elsewhere, resulting in no overall net loss. Example: Restoring 1.5 ha of native prairie to offset 1 ha of grassland lost to turbine pads. Practical application: Guides offset design and monitoring. Challenges: Quantifying "equivalence" across different ecosystems.

Offshore Turbine Foundations – Related terms: monopile, jacket, gravity base, seabed disturbance. Explanation: Structural systems that anchor turbines to the seabed, each with distinct environmental footprints. Example: Selecting a jacket foundation to reduce noise during installation. Practical application: Impacts on benthic habitats are evaluated in the EIA. Challenges: Balancing engineering feasibility with ecological sensitivity.

Noise Propagation Model – Related terms: sound attenuation, terrain effects, meteorological correction. Explanation: A computational tool that predicts how sound generated by turbines travels through the environment, factoring in topography and atmospheric conditions. Example: Using the ISO 9613-2 model to estimate nighttime noise levels for nearby residents. Practical application: Informs turbine spacing and curtailment strategies. Challenges: Accurate meteorological data are often limited.

Operational Emissions – Related terms: indirect CO_2, supply chain, maintenance travel. Explanation: Greenhouse gas releases associated with the ongoing operation of a wind farm, primarily from maintenance vehicle fuel use and electricity consumption of auxiliary equipment. Example: Estimating diesel use for turbine blade inspections. Practical application: Included in life-cycle carbon accounting. Challenges: Variability in maintenance schedules and fleet efficiency.

Outreach and Public Participation – Related terms: stakeholder meetings, comment periods, transparency. Explanation: Structured activities that inform and involve the public in the EIA process, fostering acceptance and identifying concerns early. Example: Hosting a community open house to present visual impact simulations. Practical application: Can reduce litigation risk and improve project design. Challenges: Achieving meaningful engagement beyond token consultation.

Overflight Impact Assessment – Related terms: bird flight paths, radar tracking, turbine siting. Explanation: Study of how turbine placement may intersect with avian overflight routes, potentially increasing collision risk. Example: Mapping raptor migration corridors using GPS telemetry. Practical application: Adjusts turbine layout to avoid high-density corridors. Challenges: Limited data for nocturnal migrants and dynamic flight patterns.

Permitting Process – Related terms: licensing authority, conditional approval, compliance timeline.

Explanation: The administrative sequence through which a wind project obtains the legal authorizations required for construction and operation, often contingent on satisfactory EIA outcomes. Example: Securing a wind-farm permit from the national environmental agency after EIA review. Practical application: Defines milestones for developers. Challenges: Inter-agency coordination and potential for procedural delays.

Phase-out Strategy – Related terms: decommission schedule, asset retirement, financial assurance. Explanation: A plan outlining the systematic removal or repurposing of turbines as they reach the end of their economic life, minimizing residual impacts. Example: Staggered removal of turbines over a ten-year period to reduce habitat disruption. Practical application: Integrated into the EMP to assure regulators. Challenges: Predicting future market conditions for reclaimed components.

Photovoltaic-Wind Hybrid Sites – Related terms: co-location, land-use efficiency, grid integration. Explanation: Projects that combine solar panels with wind turbines on the same parcel to maximize renewable output while sharing infrastructure. Example: Installing PV arrays between turbine bases on a flat site. Practical application: Can reduce overall land disturbance. Challenges: Complex permitting due to multiple technology footprints.

Plant Species Conservation – Related terms: endangered flora, habitat protection, seed banking. Explanation: Measures to protect rare or threatened plant species identified during the ecological survey, often involving avoidance or translocation. Example: Relocating a protected shrub before foundation excavation. Practical application: Documented in the mitigation plan. Challenges: Limited success rates for translocation and long-term monitoring needs.

Procedural Fairness – Related terms: due process, hearing rights, transparency. Explanation: The requirement that all parties affected by the wind project have equal opportunity to present evidence and comment on the EIA. Example: Providing a written response window after public notice of the draft EIA. Practical application: Strengthens legitimacy of the decision. Challenges: Ensuring timely responses and managing large volumes of stakeholder input.

Project Screening – Related terms: threshold criteria, categorical exclusion, preliminary assessment. Explanation: The initial determination of whether a proposed wind project requires a full EIA based on size, location, and potential impacts. Example: A small 5 MW turbine may be categorically excluded under national guidelines. Practical application: Saves resources for low-impact projects. Challenges: Ambiguities in screening thresholds can lead to disputes.

Public Health Impact Assessment – Related terms: noise, shadow flicker, air quality. Explanation: Evaluation of how project-related factors may affect human health, including stress from noise, visual disturbance, and potential respiratory effects from dust. Example: Assessing community sleep quality changes due to nighttime turbine operation. Practical application: May require mitigation such as curtailment during certain hours. Challenges: Quantifying subjective health outcomes and attributing them directly to the project.

Regulatory Compliance Monitoring – Related terms: audit, permit conditions, non-compliance penalties. Explanation: Ongoing verification that the wind project adheres to all environmental permits, standards, and mitigation commitments. Example: Quarterly reporting of noise levels to the environmental agency.

Practical application: Provides evidence for continued operation authorization. Challenges: Data integrity, resource allocation for monitoring, and potential regulatory changes.

Renewable Energy Certificate (REC) – Related terms: green credit, market mechanism, compliance trading. Explanation: Tradable certificates representing a megawatt-hour of renewable electricity generated, often used to meet statutory renewable portfolio standards. Example: Selling RECs from a 200 MW wind farm to utilities. Practical application: Generates additional revenue streams. Challenges: Price volatility and verification of actual generation.

Risk Assessment Matrix – Related terms: likelihood, consequence, scoring system. Explanation: A tool that plots the probability of an impact occurring against its severity to prioritize mitigation efforts. Example: Assigning a high-risk rating to turbine blade strike on an endangered bat species. Practical application: Guides resource allocation for monitoring and mitigation. Challenges: Subjective weighting and data scarcity for rare events.

Seasonal Migration Study – Related terms: phenology, telemetry, temporal overlap. Explanation: Research focused on understanding the timing and routes of migratory species that may intersect turbine operations. Example: Conducting spring-time surveys of monarch butterfly pathways across a proposed site. Practical application: Enables temporal curtailment during peak migration periods. Challenges: Inter-annual variability and limited monitoring windows.

Site Selection Criteria – Related terms: wind resource, land availability, environmental sensitivity. Explanation: The set of factors used to rank and choose optimal locations for wind turbines, balancing energy yield with ecological and social considerations. Example: Prioritizing sites with high average wind speed and low habitat value. Practical application: Reduces overall environmental footprint. Challenges: Competing objectives and data resolution limitations.

Soil Erosion Control – Related terms: sediment traps, vegetative buffer, silt fences. Explanation: Measures implemented during construction to prevent soil loss and downstream water quality degradation. Example: Installing straw wattles on slopes near turbine foundations. Practical application: Reduces turbidity impacts on adjacent streams. Challenges: Maintaining controls during heavy rain events and after equipment removal.

Sound Attenuation Strategies – Related terms: acoustic shielding, turbine blade pitch, operational curtailment. Explanation: Techniques used to reduce noise emissions from turbines to meet regulatory limits and community expectations. Example: Adjusting blade pitch to lower low-frequency noise during night hours. Practical application: Helps achieve compliance with nighttime noise thresholds. Challenges: Potential trade-offs with energy production efficiency.

Species Distribution Modeling – Related terms: niche modeling, occurrence data, predictive mapping. Explanation: Statistical methods that estimate the geographic range of species based on environmental variables, informing impact zones. Example: Using MaxEnt to predict the distribution of a rare ground-nesting bird across the project area. Practical application: Identifies high-conservation value zones to avoid. Challenges: Limited occurrence records and model uncertainty.

Stakeholder Mapping – Related terms: influence-interest matrix, engagement plan, communication channels. Explanation: Process of identifying all individuals, groups, and institutions affected by or interested in the wind project, and categorizing their level of influence and concern. Example: Mapping local landowners, NGOs, and regulatory agencies. Practical application: Prioritizes outreach efforts. Challenges: Dynamic stakeholder interests and potential conflicts.

Sustainability Assessment – Related terms: triple bottom line, environmental, social, economic indicators. Explanation: Holistic evaluation of a wind project's long-term viability, encompassing ecological health, community well-being, and financial performance. Example: Scoring the project against the UN Sustainable Development Goals. Practical application: Supports strategic decision-making and investor confidence. Challenges: Integrating disparate metrics into a coherent framework.

Temporal Impact Analysis – Related terms: seasonal variation, construction phase, operational phase. Explanation: Assessment that differentiates impacts occurring during distinct project stages, recognizing that effects may vary over time. Example: Higher noise during construction versus lower operational noise. Practical application: Allows staged mitigation measures. Challenges: Coordinating monitoring schedules across phases.

Terrain Roughness Modeling – Related terms: surface heterogeneity, wind flow simulation, CFD. Explanation: Simulation of how land surface variations (e.g., hills, vegetation) affect wind speed and turbulence, influencing turbine siting and performance. Example: Using CFD to predict wind shear over a ridgeline. Practical application: Optimizes turbine placement for maximum energy capture. Challenges: Requires high-resolution topographic data and computational resources.

Thermal Impact Assessment – Related terms: microclimate, heat island, turbine wake temperature. Explanation: Evaluation of how turbine operation may alter local temperature regimes, potentially affecting vegetation or wildlife. Example: Measuring slight cooling in the turbine wake during summer months. Practical application: Incorporates findings into habitat impact analysis. Challenges: Detecting subtle temperature changes amidst natural variability.

Transmission Line Right-of-Way (ROW) – Related terms: corridor width, easement, vegetation management. Explanation: The land corridor reserved for electrical transmission infrastructure associated with the wind farm, often requiring clearing and maintenance. Example: Defining a 30-meter ROW for a 220 kV line. Practical application: Impacts land use and can create linear habitat fragmentation. Challenges: Negotiating easements with multiple landowners and mitigating edge effects.

Traveling Wave Energy – Related terms: offshore wind, hybrid platforms, wave-wind synergy. Explanation: The concept of co-locating wave energy converters with wind turbines to capture both wind and wave resources, potentially increasing site productivity. Example: Installing a point absorber at the base of an offshore turbine. Practical application: May affect marine habitat assessments. Challenges: Complex engineering integration and expanded environmental scrutiny.

Underground Cable Installation – Related terms: trenching, bore-hole, electromagnetic fields. Explanation: The process of placing electrical cables below the surface to reduce visual impact and exposure to weather.

Example: Horizontal directional drilling to route cables beneath a protected meadow. Practical application: Minimizes surface disturbance and visual intrusion. Challenges: Higher installation costs and risk of underground habitat disruption.

Upstream Cumulative Impact – Related terms: watershed analysis, sediment load, water quality. Explanation: Assessment of how upstream land-use changes, including those related to turbine construction, affect downstream ecological conditions. Example: Evaluating increased sediment from access road grading on downstream fish spawning grounds. Practical application: Informs mitigation like sediment basins. Challenges: Attribution of impacts across multiple upstream activities.

Vegetation Clearance Permit – Related terms: deforestation, re-vegetation, regulatory approval. Explanation: Authorization required to remove native vegetation for turbine foundations or access roads, often conditional on mitigation measures. Example: Securing a permit that mandates planting native species elsewhere. Practical application: Ensures legal compliance before clearing begins. Challenges: Delays due to permit review and stakeholder objections.

Visual Impact Mitigation – Related terms: colour blending, turbine siting, landscape buffering. Explanation: Strategies to reduce the visual prominence of turbines, such as using non-reflective coatings or placing turbines behind natural ridgelines. Example: Applying matte grey paint to turbine towers. Practical application: Addresses community aesthetic concerns. Challenges: Balancing visual mitigation with optimal energy yield.

Wildlife Curtailed Operation – Related terms: turbine shutdown, seasonal curtailment, adaptive management. Explanation: Temporary reduction or cessation of turbine rotation during periods of high wildlife activity to lower mortality risk. Example: Curtailing turbines from dusk to dawn during peak bat emergence. Practical application: Directly reduces collision events. Challenges: Energy loss, coordination with grid operators, and accurate activity forecasts.

Wind Resource Assessment – Related terms: anemometry, Weibull distribution, capacity factor. Explanation: The systematic measurement and analysis of wind speed and direction over time to estimate the energy potential of a site. Example: Deploying a 2-year lidar campaign on a hilltop. Practical application: Determines turbine rating and layout. Challenges: Data gaps, terrain effects, and long-term variability.

Wind Turbine Noise Standards – Related terms: A-weighted decibels, night-time limit, regulatory threshold. Explanation: Legal limits governing the sound pressure level emitted by turbines, often differentiated between daytime and nighttime. Example: A 45 dB(A) night-time limit at the nearest residence. Practical application: Guides turbine selection and placement. Challenges: Enforcement in remote areas and cumulative noise from multiple turbines.

Zero-Emission Commitment – Related terms: carbon neutrality, net-zero, offset strategy. Explanation: A pledge by the project developer to achieve net-zero greenhouse gas emissions over the project's lifespan, typically through renewable generation, efficiency measures, and offsets. Example: Purchasing carbon credits to balance construction-phase emissions. Practical application: Enhances project marketability and aligns with climate goals. Challenges: Accounting for indirect emissions and ensuring offset integrity.